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West Europe Report

SCIENCE AND TECHNOLOGY

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WEST EUROPE REPORT

SCIENCE AND TECHNOLOGY

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ADVANCED MATERIALS

SIEMENS-CORNING PLANT TO MANUFACTURE OPTICAL FIBERS

Duesseldorf HANDELSBLATT in German 4 Dec 84 p 12

[Article: "A Plant with an 80,000 glassfiber-kilometer Capacity"]

[Text] Together, the Siemens AG, Munich, and the Corning Glass Works, Corning, N.Y., will establish in Neustadt near Coburg the first large-scale glassfiber plant in the FDR.

Investments for the first stage with an annual capacity of 80,000 fiber kilometers amount to DM 70,000,000. This already includes the costs of infrastructure measures permitting a production expansion to more than 200,000 fiber kilometers per year. However, at what time this second expansion stage with over 200,000 fiber kilometers per year will be realized will be decided in the final analysis by the European market.

In any event, this production site for light wave conductors (glass fiber), which was the purpose of establishing the Gesellschaft fuer Lichtwellenleiter mbH & Co, KG, Neustadt, is almost as large in its first expansion stage as the joint glass fiber plant in Berlin, the AEG, Kabelmetall, PKI (Philips), Siemens and SEL for an anticipated annual capacity of 100,000 fiber kilometers, which had failed because of the objection of the Federal Cartel Bureau. About 100 workers will be employed in the glass fiber plant Neustadt located in the Upper Frankonia boundary sector in its initial phase.

Siemens and Corning expect full utilization of the capacity, among others things, through export orders. Both partners agree that additional partners can be included at a later time. Since production is to start as soon as early 1986, construction of this new production site is scheduled for next year. Siemens is already manufacturing communication cables in Neustadt with a work force of 750. Since also power cables are manufactured in Neustadt, the work force at this Siemens location is about 2,000.

According to Siemens, construction of the new light wave conductor plant in Neustadt also ensures that a drop in production of copper communications cable in the neighboring cable and conduit factory can be profitably achieved through the use of light wave conductors, based on market requirements. These light wave conductors will be produced following the OVD process developed by Corning, by which about 500,000 fiber kilometers have been produced already; this means that Corning has produced more glass fiber cables than any other manufacturer. Siemens and Corning have been working

together since 1973 in two joint Siecor companies, one each in the Federal Republic and in the United States. Corning brought to these 50:50 partnerships its knowledge in glass technology, Siemens provided its know-how in cabling techniques for light wave conductors.

This made the Siecor Company, which purchases light wave conductors from Corning, the second-largest supplier for light wave conductor cables in the US, and thus also on the world market which, at the present time, is estimated at about one-and-one-half billion DM. Siemens expects the annual market growth to go to about 40%. With a market ratio of 35%, the Corning-Siemens group is in second place, closely behind At&T.

In a pilot facility in Munich, Siemens manufactures at present cables for communications and industrial uses, also with Corning fibers. Quite recently, Siemens announced construction of a plant for the manufacture of components in the light wave conductor technology in Berlin, where, with an overall investment of DM 230 million, 600 new work places are being created in two expansion stages.

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CSO: 3698/135

AEROSPACE

FRG'S DFVLR READY FOR PARTICIPATION IN SPACE STATION

Frankfurt/Main FRANKFURTER ALLGEMEINE ZEITUNG in German 3 Dec 84 p 10

[Text] A decision will have to be made in Bonn on December 12 as to whether or not the Federal Republic should or should not participate in the space station of the Americans earmarked for 1992. It is anticipated that the station will probably cost eight billion dollars. It is to be expected that the Cabinet will give the green light for the cooperation, even though at this hour it is not yet clear how it will be financed. At any rate, a participation by Bonn should cost about a billion dollars.

Professor Jordan, chairman of the board of the "German Research and Testing Institute for Air and Space Travel" (DFVLR), stated at the general annual assembly of his organization in Braunschweig that, after the successful construction of the manned European space laboratory Spacelab, people are at least ready to cooperate in the technology of the American station. He also pointed out that one of the most important European facilities for aviation research is now to be established in Koeln-Porz, the seat of the DFVLR. This is the "Transonic European Wind Tunnel", which is to permit the aviation industry much more accurate measurements for future airliners and other aircraft than had been the case to date. This is also of importance in view of the increasing competition between the large European and American airplane manufacturers.

The same applies to the new Propfan drive (propeller fan), which is to save up to 30 percent fuel for airliners as early as in the late nineties. This means a new type of curved propellers, which are to bring airplanes to the speed of present-day jet engines. Jordan's comment to this: "These technologies will possibly have a decisive effect in the coming years on competition between European and American airplane manufacturers. We therefore must not neglect research and development in any event." In fact, some American companies, such as General Electric or Hamilton Standard, are already working with the help of Nasa on the new aircraft propulsion systems.

Whether space station or aviation, the DFVLR - at 3,700 workers and an annual budget of 430 million marks the largest engineering sciences research facility of the Federal Republic - is well prepared for any future tasks. As Jordan said in Braunschweig, "we lack neither perspectives nor the willingness and ability to boldly grasp the new tasks".

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AEROSPACE

BRIEFS

SNPE CHEMICAL BRANCH REVENUE--In 1983, Department C, i.e. the department regrouping the "chemical" operations of SNPE [National Powders and Explosives Company] in Toulouse, achieved sales of FF 612 million. This represents a 23 percent increase in revenues, and 8 percent by volume. It is due in part to sales of unsymmetrical dimethyl hydrazine (UDMH) to the National Center for Space Studies (CNES). This is the liquid fuel used to propel the Ariane rocket. A good deal for SNPE. But also a good deal for France which used to import its propellant fuel. For phosgene and its derivatives, 1983 sales reached record levels. Production increased by 27 percent and the Toulouse plant exported 58 percent of its production, UDMH not included. Due to a drop in French and U.S. consumption, sales in the nitrocellulose sector (civilian and military applications) increased by only 12 percent. [Text] [Paris INDUSTRIES ET TECHNIQUES in French 10 Nov 84 p 45] 9294

CSO: 3698/209

CIVIL AVIATION

MBB USES SUPERPLASTIC FORMING, DIFFUSION BONDING FOR ALLOYS

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 3 Dec 84 p 7

[Text] The need for the greatest economy possible when operating airplanes requires, among other things, a low structural weight and low manufacturing costs. A new method, called "superplastic forming" and "diffusion bonding" is considered to be an extremely effective technology of lowering production costs drastically. Both are processes developed to serial maturity at the Messerschmidt-Boelkow-Blohm GmbH in Hamburg.

In superplastic forming, the titanium material is brought into almost any desired structural shape. In diffusion bonding, titanium sheets are so joined that a single metallurgical structure evolves. Both processes occur under high heat and under gas pressure.

Titanium has become an entirely indispensable material for certain sectors of aircraft construction. It is in particular demand wherever high strength is required together with great elasticity and where it is important to withstand thermal structure loads. In spite of the excellent properties, the component amounts to only four percent in the structural weight of the Airbus. This small proportion can be explained by the high semiproduct price and the expensive processing technique. For example, it is almost impossible to form titanium alloys at room temperature. Both facts have forced a cost-conscious builder to date to consider this material as a rather exotic one.

The so-called alloyed titanium sheets used in airplane construction have an added six percent aluminum and four percent vanadium. This titanium alloy exhibits the property of deforming at certain parameters, i.e., a heat of 900 to 925°C and a gas pressure of only three to four bars. Titanium becomes superplastic in this process. This means that, like a ductile dough, it can be pressed into any desired shape.

Development work in this material forming and bonding technology proceeds with a press whose tool halves can be electrically heated. The two tool halves serve to hold the metal parts to be formed and bonded down; they are held together by a stamp print. Heating coils in firebricks enclosing the inner space, as well as gas channels leading inside and pressure regulating facilities complete the new titanium forming facility.

After having been brought to a temperature of a little over 900°C and thus transformed into a doughy, or rather, superplastic state, the titanium sheets are formed in the furnace-like tool under a pressure of inert [illegible] gas slowly rising from zero to three bars. The shaping tool is a cast-steel block with the appropriate grooving, in which the superplastic titanium sheet receives its structural shape. Almost any desired structural shape, even cavities, can be made with this method.

Diffusion bonding proceeds prior to or in immediate succession to forming in the same way. Two titanium sheets become one single sheet part at 900 to 925°C and under a gas pressure, this time of 10 to 60 bars. Atom- and grain structure enter into a composition, so that both sheets form a metallurgical entity at the welding points after the process. Also different materials, such as for example steel, aluminum and titanium, can be bonded with each other by means of diffusion bonding.

The reason for the development of this new type of forming and bonding process lies in the fact that it makes it possible to lower production costs for titanium structures up to 60%. With this process, the builder can use titanium to a greater extent than possible so far in airplane structures, so as to utilize the excellent properties of the material more completely.

9243
CSO: 3698/139

COMPUTERS

FINLAND'S NOKIA INCREASES SOFTWARE EXPORTS

Oslo POLYTEKNISK REVY in Norwegian Sep 84 p 51

[Article: "Nokia Data: Strong Growth"]

[Text] Nokia Data in Finland can note a significant increase in the export of software for industrial and commercial use. In order to achieve even further growth and, according to the company, "create a strong opening for expanded software exports," Nokia recently has signed an agreement with the Swedish Honeywell Bull AB, which is to market Nokia's software in Sweden.

Last year, the software portion of Nokia Data's total production was about 23 percent, but has increased to about 30 percent this year. The company states that this is the result of a conscious effort to strengthen the software side.

The reason for this effort is the steadily increasing role which software plays in automated and data-processed systems. A concern which today wants to invest in data processing first chooses suitable software, and then the machinery which fits the software.

Nokia Data's Information Systems Marketing division produces and markets software for use in Honeywell DPS6 systems. The five most important products are a system for control of production and inventory (PRIMAS), a program for technical maintenance (TEKUS), a system for wholesaling (HERMES), a special system for printing (PAINOS), and a program for professional program development (NOPSA).

Nokia Data has expanded rapidly from being a typical seller of machines to becoming a seller of total systems. The entire electronics group sales amounted in 1983 to approximately 1.4 billion Finnish markkas, of which, the data division accounted for approximately 40 percent. For this year, the electronics group has projected sales of 3.6 billion markkas. Included in this figure are projected sales for the newly-acquired companies, Salora and Luxor.

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CSO: 3698/144

COMPUTERS

SIEMENS INTRODUCES FAST COMPUTER WITH PIPELINE ARCHITECTURE

Leinfelden-Echterdingen DIE COMPUTER ZEITUNG in German 3 Oct 84 p 1

[Text] Munich (hm). The Siemens VP100/VP200 vector processor system (VP system) has been designed to solve especially high volume numerical problems in commercial, scientific and technical EDP applications. For fast and economic processing, such tasks are processed in vector form and executed moreover in parallel. With this, the Munich firm has opened new paths.

The VP system consists of two models, the VP100 and the VP200. They are based on pipeline architecture with multiple pipeline units. The maximal performance of the VP100 is 250 MFlops and that of the VP200 500 MFlops (mega or million floating point operations per second) in processing 64-bit words. With that, the Siemens VP system is among the world's fastest computers.

Both the VP100 and VP200 have a scalar and a vector unit each. The smallest VP100 has 32MB of main storage; the largest VP200 has 256MB. Both models also differ in size of vector and mask registers. Vector unit cycle time is extremely fast at 7.5 nanoseconds. The VP100 can be upgraded to the VP200 on site. The new VP system is compatible with computers from the main competitors and can be integrated into corresponding EDP environments and the Siemens 7800 mainframe system.

Fortran is the programming language for the Siemens VP system. Existing Fortran-77 programs can run on the VP system after simple recompilation without further modifications. With the high performance combination of hardware and software, especially with the automatic vector capabilities of the VP Fortran-77 compiler, program conversion from a general-purpose computer to the Siemens VP system is considerably facilitated for the user. New program development is especially efficient because of the diverse interactive Fortran software products.

The price for the new VP system starts at 16 million marks for the VP100 with 32MB and 16 channels. The price for the software (VSP operating system and accompanying software products) starts at around 50,000 marks monthly rental.

8545
CSO: 3698/174

COMPUTERS

OVERVIEW OF LEADING-EDGE RESEARCH AT FRENCH CNRS LAB

Paris MICRO ET ROBOTS in French Jan 85 pp 42-50

[Article by P. Truc: "The LIMSI"]

[Text] Robotics, voice recognition and synthesis, CAD [computer-aided design], mechanics: such is the leading-edge research carried out at the LIMSI [Mechanical and Engineering Sciences Data-Processing Laboratory].

The Orsay Center (Essonne) which associates the Paris-XI Faculty and many CNRS [National Center for Scientific Research] laboratories is known worldwide for the contributions it has made to the international community in advanced research fields.

We had an opportunity to visit one of the Orsay center laboratories: the LIMSI or Mechanical and Engineering-Sciences Data-Processing Laboratory is geared to advanced research in critical fields such as robotics, voice recognition and synthesis, CAD and mechanics. It was created in 1945 by dean Joseph Peres and was first known as Experimental Analog Computing Laboratory of the Blaise Pascal Institute and later as Analog Computing Center, and eventually it assumed its present name of LIMSI.

In the 1970's, the data-processing boom and Prof Lucien Malavard's "liberalism" gave rise to new research orientations:

- CAD research led to the specification of the Euclid language which is now marketed in the United States and Japan;

- Research on spoken communication has led to the industrial development of voice synthesis and recognition products;

- As for robotics, it was introduced at the LIMSI by its previous director, Guy Renard; robotics research encompasses wide fields, from control and the generation of plans of action to perception functions;

- Finally, experimental research in fluid mechanics has found an application both in designing the profile of the TGV [very-high-speed train] and in building Commandant Cousteau's "Windmill," a revolutionary sailless sailboat...

Robotics

Research in robotics at the LIMSI started in 1977 and led to the formation of a research team in 1980, which was integrated into the ARA [expansion unknown] project. This project provides for the convergence of all research programs and contributes to their development. The team is headed by Angel Osorio and devotes much attention to real-time data processing, from the point of view of hardware as well as software, which led it to design and implement real-time oriented software. For instance, this is the case of the SIMIR system (Interactive Multitask System for Robotics Integration) which should lead to the production of a perfectly portable robotics software program. This will involve an architecture of the distributed-network type in which each user will use a sophiticated work station.

Data-processing research related to "robotics" is the reason that the team is participating in the ARA project, and much of the team's research will therefore focus on it during the next few years.

Generally speaking, research is oriented to the triplet decision-perception-communication, from the point of view of third-generation robots.

Of all the research done on perception, stereovision, using a K2D methodology, represents a theme that appears to correspond to today's needs as well as to those of the future robotics. These methods require a closer examination of purely two-dimensional techniques (probably 75 percent of all industrial cases) and make it possible to complete short-term projects with limited means.

Research on decision-planning is approached from the point of view of the implementation of a flexible assembly cell. All these research projects have one objective in common: the convergence of the methods widely used in artificial intelligence toward advanced robotics applications so as to define a distinctive approach for assembling and handling. The implementation of decision-making systems such as the inference engine constitutes the clue to this research.

The goal of the team's experiments is to implement a flexible assembly cell, and it is already using two manipulators with six degrees of freedom: one Acma TH8 robot delivered in December 1983 under the ARA project, and the transfer robot of the laboratory to which a three-axis wrist was added. The vision processor used (Nim 628) will digitize images on 16 levels of gray; however, it appears to be inadequate and conversion to a processor with 64 levels is being considered. In addition, using a multiprocessor computer (SM 90) connected to sophisticated terminals appears to be the solution best adapted to the team's goals and it should provide rapid access to CIRCE [expansion unknown] computers.

The Robotics team of the LIMSI also provides third-cycle teaching: DEA [advanced studies diploma] in industrial engineering at the National School of Engineering, GEA [expansion unknown] of the Montpellier University; it is responsible for the robotics segment of the Paris-XI data-processing DEA. Lectures have been given in teaching centers (ECP [Paris Central School of Engineering], ENST [National Advanced School for Telecommunications], Cachan and Orsay IUTs [university technological institutes]). The team has contri-

buted to the organization of robotics seminars (Paris congress of the International Federation for Information Processing, Industrial Robotics at Bilbao, Robobea in Barcelona) and has presented communications at eight congresses. It was represented on the commission of the Ministry of Industry and Research (robotics theme) on "Data-Processing Needs for Research" and contributed to the implementation of the data-processing guidelines of the CNRS. The team has frequent scientific contacts with five French and four foreign laboratories. One third of its personnel devotes most of its activities to the ARA project (implementation of canonic experiments, participation in scientific councils, completion of scientific research projects, etc.). It has two current contracts: one with the DRET/ETCA [Directorate of Research, Engineering and Technology/Central Technical Establishment for Armament] (image-acquisition chain); the other with Renault (ARA goal-product operation).

As a significant example of the research carried out by the LIMSI, we could mention the "decision-making system for advanced robotics perception" developed by Serge Koulondjoin, A. Meller and A. Osorio.

SIMIR-V

SIMIR-V is a flexible and interactive shape-analysis decision-making system for assembly robots. It uses a formal representation of knowledge to identify an object, and an independent decision-making strategy. It uses primitives to extract data concerning the object to be identified from a digitized image with 16 levels of gray.

The inference engine operates according to rules containing variables. The results of the inference make it possible to establish a correlation between the object perceived and the object filed. If more than one object is identified for a given perception, or if a perception does not result in a single interpretation, new data are acquired by exploring a sub-assembly (or a message indicating ambiguity in the analysis is produced). The statement of knowledge representation (or learning) provides a fully open-ended system.

This research has to do with the handling of objects: therefore, it must explicit the decision-making aspects of the vision system proper, and its use by software. As a result, the decision-making capacities of the system must be extended to the following levels:

- the vision system must be able to reexamine various image-processing stages;
- the software must treat the vision part as a perfectly flexible whole.

Above all, the following points must be considered. On the one hand, many vision systems are developed independently of the remainder of the structure, which leads to surprises when they are integrated: in most cases, people realize that the host system could have benefited from valuable data provided by the vision module, but these data are not available because they were deemed irrelevant when the module was developed separately. For instance, the lack of any object identification, confusion between two objects, or instant object recognition... can consequently enhance the capabilities of the system as a whole. Indeed, when these data are available, the monitoring module can

decide to move the robot or to use a particular sensor knowing exactly to what extent the object was identified. Better still, knowing the position of a partially recognized element (through the vision module), the robot can grasp it and replace it in such a position that the vision module will be able to identify it without any chance of error.

On the other hand, if the vision module can provide detailed data concerning the state of its knowledge-acquisition process, the system can require additional image processing. For instance, let us assume that recognition remains ambiguous: it is then possible to select a sub-assembly of the image and apply to it more sophisticated processing routines. Or again, if the image obtained is too convoluted (too many outlines), it is possible to alter the digitization parameters to obtain a new image.

Acquisition Processes

They use global and relational variables concerning the image whose edges have just been extracted. The global variables include the center of gravity, the distance from edge points to the center, the area, the moments of inertia.

Object Representation

A structural representation is used. For instance, a washer can be described as follows:

```
Washer: type (circle)
        characteristic (hole)
        hole (included)
```

which means that the washer is some sort of a circle. Its characteristic is that it includes a hole. Real objects, like the washer, are distinguished from generic objects like a circle.

The structure corresponding to the circle will be:

```
Circle: type (shape)
        identification (syn) (S/P)
        S/P (5) (7)
        SYM (8) (11)
```

Here, the "identification" element indicates that two data, "SYM" (relation of symmetry) and "S/P" (area/parameter ratio), must be used to identify a circle. The value of S/P (5, 7) indicates that this ratio must be in the 5-7 range.

We have already expressed the fact that the washer is a sort of circle and that its main characteristic is that there is a hole in it. We now need a description of the hole:

```
Hole: type (characteristic)
      identification (SYM) (S/P)
      SY/ (1) (2)
```

This representation enables the system to process diverse requests such as "find the washer," "a hole," "a circle," "a hole in a circle," etc. The same representation is used for data produced by the image-extraction process, for which global and relational variables will therefore be used.

Data Acquisition

The inference engine is a production system called APSIS (A Production System for Integrated Systems) which was developed by the authors of this research.

It is a "partitioned" production system which provides considerable organizational flexibility and is based on the concept of knowledge-sources specialists communicating through a shared factual database. Each knowledge-sources specialists contains several rules.

For instance, the "elementary identification" expert contains rule OB4:

```
OB4 (OBJECT ?X)
    (PRED(/LI 0 IDENTIFICATOR (NOT??))
    (MAPCAR (EVAL(INSTANTIE'CLASSEIDENT'X?))
    'NLAMBDA (E)
    (/EC 1 IDENTIFICATOR
    (X?E?)>
```

This means: "to recognize an object not yet identified, process the edges corresponding to the description variables and give them to the 'in-depth identification' expert." For the next expert, this rule will generate the structure (WASHER (CLASS 0050)) which means that the CLASS 00 edge corresponds to the description of the washer with a 50-percent level of uncertainty. This percentage is processed in accordance with the range limits of the various data included in the washer description.

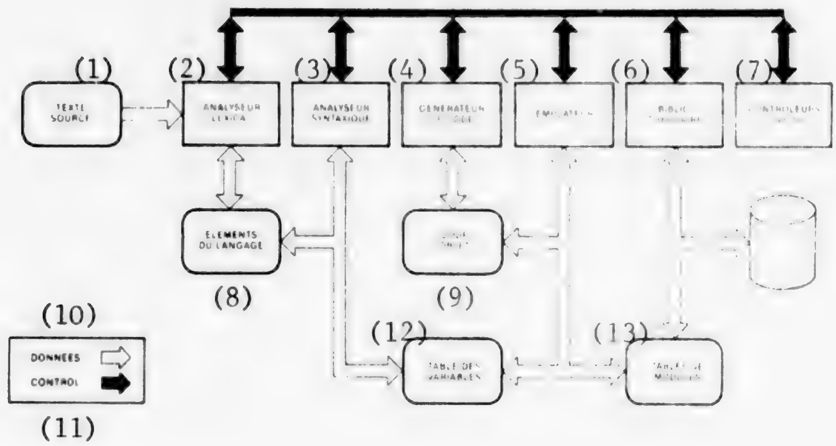
The use of rules in processing makes for increased flexibility. Also, in the case of a manipulator-robot grasping objects on a conveyor belt, this modularity makes possible a correlation between vision and action. Finally, since only a restricted number of data are extracted from an image, the processing time is short enough to allow for a real-time answer.

The Strategy

The strategy used for identification is flexible and determined dynamically. In other words, depending on the demands expressed by the system, the order in which the knowledge-sources specialists are applied can vary considerably. Actually, these demands may range from a very general "Identify all the objects," to the specific request "Tell me if the washer is actually there!".

Ultimately, the system will go through the following loop:

a) model-based interference [as published] engine: when modeling the object, try to reproduce its structural characteristics (using mainly scalar variables);



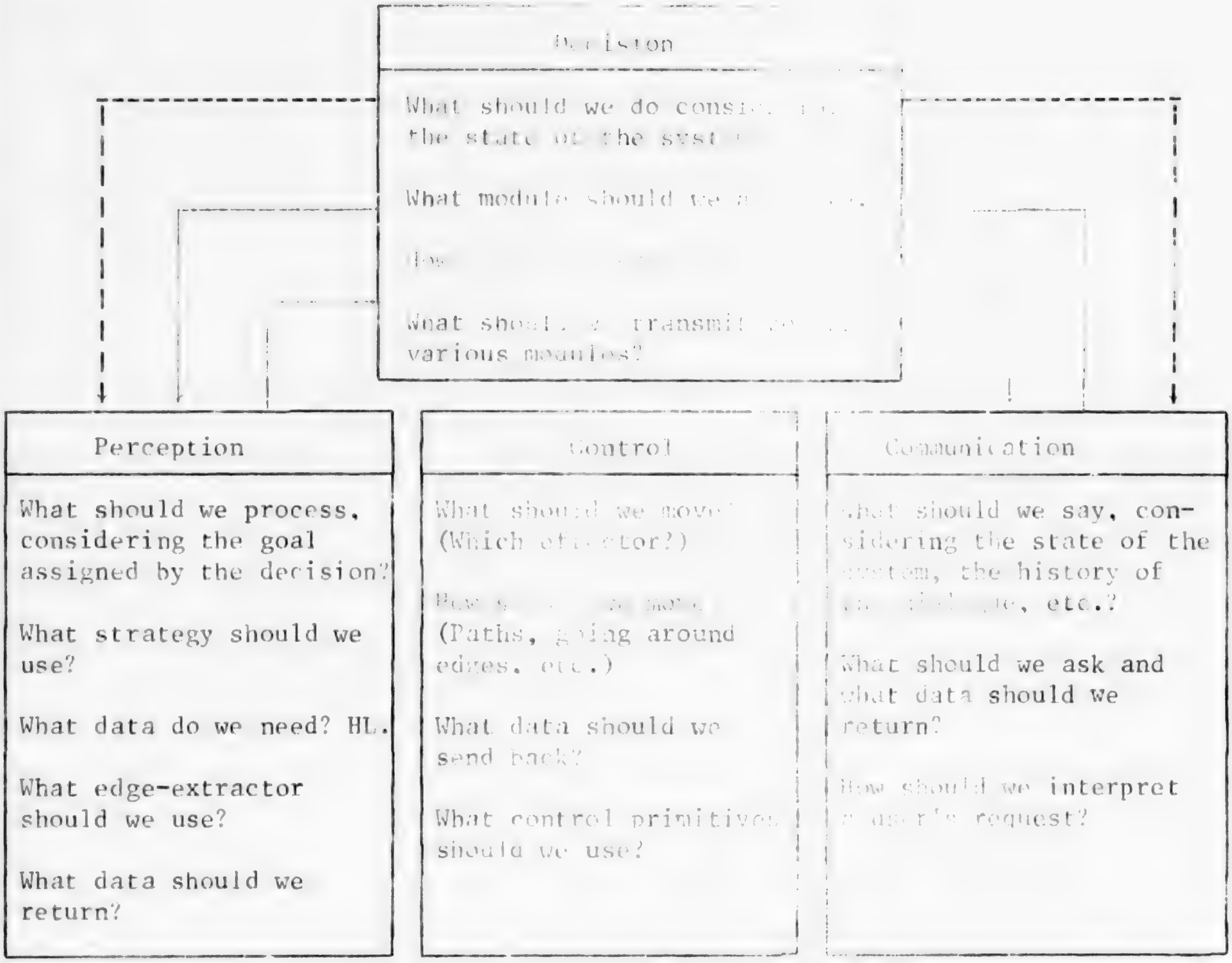
Key:

1. Source text
2. Lexical analyzer
3. Syntactical analyzer
4. Code generator
5. Emulator
6. Librarian
7. Miscellaneous controllers
8. Language elements
9. Object code
10. Data
11. Control
12. Table of variables
13. Table of modules

The Grammar of Grammars

```
1:<RULE>              ::= <AUXILIARY>'::=' <DEFINITION> "..
2:<DEFINITION>        ::= <OPTION> ('!' <OPTION>)*.
3:<OPTION>            ::= <TERM> +.
4:<TERM>              ::=  '[' <DEFINITION>']'.
                        !( <ITEM> ['*' ! '+']).
5:<ITEM>              ::= <AUXILIARY> ! <TERMINAL> ! '('<DEFINITION>')'.
6.<AUXILIARY>         ::= '<' <VARIABLE> '>'.
7.<TERMINAL>          ::= '"' <VARIABLE> '"'.
```

Rule 6 defines the auxiliary vocabulary.
Rule 7 defines the terminal vocabulaty.
The symbol '!' represents the exclusive OR.
The symbols '[' and ']' represent zero or one occurrence.
The symbol '*' represents zero or several occurrences.
The symbol '+' represents at least one occurrence.



Traditional hierarchic diagram of a robotized system;
a few decision opportunities are indicated for each
module.
HL: Possible hierarchic levels
Dotted lines: control
Solid lines: data

b) data-based interference [as published] engine: when processing the data of the image obtained, reproduce the object (using mainly relational data);

c) if no consistent interpretation is found, ask for new data and go back to a).

Processing Alterations

Alterations are possible at data-extraction as well as at image-acquisition level. At data level, part of the image can be enlarged and receive further processing. For digitization, it is possible to alter certain parameters (number of points to take into account, frequency ratios, etc.). However, assessing the effect of these parameters on the digitized image is not always obvious.

Experimental Setup

The camera is positioned so as to perceive the working area at an angle of approximately 30°. It is assumed that there can be no overlapping of objects and that the latter are seen in the "position in which they are normally used."

The system is written in Lisp F3 (a sub-assembly of Interlisp) and will soon be included in the SIMIR software, which will combine real-time multitask processing power and interpretation of a large group of languages.

Conclusion

We have thus clearly established the interest of formal statements in the decision-making aspects of robotics image analysis, which leads to a substantial increase in the flexibility and integration capacities of the system. For the time being, the system has the drawback that it can process only a limited number of objects (in their structural form) which makes it difficult to compare it with other systems. However, new capabilities will be added, without changing the way it is written, by means of the generalized statement of the representations used here. More globally, we can say that SIMIR-V ofers a general method for a sophisticated interaction between perception and action.

Bibliography

- M. Chambon D., "Description of digital images. Realization of the SACSO [expansion unknown] low-level module," third-cycle thesis, Paul-Sabatier University, Toulouse, 1982.

- Dyer, C.R., and Chin, R.J., "Model-Based Industrial Part Recognition Systems and Algorithms," Computer Sciences Technical Report No 538, University of Wisconsin, Madison, March 1984.

- Henninger, L., "Interactive Real-Time Software on Advanced Robotics," International Symposium on Artificial Intelligence, Leningrad, 1983.

- Nii, H.P. and Aiello, N., "AGE: A Knowledge-Based Program for Building Knowledge-Based Programs," Proceedings of the Sixth IJCAI [expansion unknown], pp 645-655.

The CAD Team

The CAD team recently created and headed by Paul Mace, researcher at the CNRS, really started filling out this year, while diversifying its research orientations.

Actually, CAD is a full-fledged discipline with many applications. This has resulted in a strong increase in the number of requests for cooperation from the public sector, both from the CNRS and others. It is then necessary to distinguish between research and services, a difficult task since what the requester calls research is often seen as a service by the LIMSI.

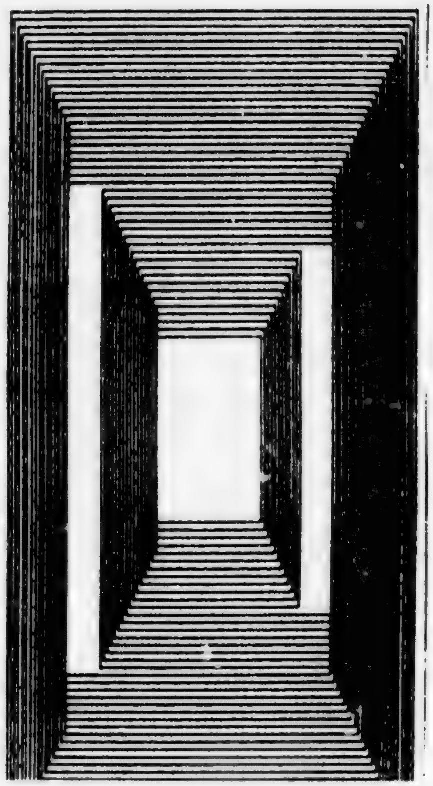
At the LIMSI, the characteristic of CAD is its research effort to model existing shapes, which brings it closer to image processing and robotics. Simultaneously, its reflection is directed to the means required for modeling: Actually, the virtual models of an object or a scene (3D model) are at present created and handled by means of powerful software programs requiring "true" computers of medium or large size. However, the needs of small or medium-size firms, laboratories and on-board robotics as far as modeling, display and animation are concerned lead to the consideration of light and interactive hardware and software architectures. Therefore, research is being oriented toward problems involving the acquisition of three-dimensional shapes and their modeling on microsystems.

Acquisition of Curved Lines and Surfaces

The object of this research is to develop interactive methods for the acquisition of curved lines and surfaces from images and hand-drawn diagrams. CAD uses practically only one acquisition method: that of descriptive geometry, i.e. a front view associated to a top view. Unfortunately, this is not always adequate to create curves. In particular, many applications call for the acquisition of a curve drawn on a digitizing tablet or already represented (old blueprints, drawings, photographs). Finally, a curve is often the image of a three-dimensional curve that must be reconstituted from the two above-mentioned views. If there is a plane of symmetry, then (in theory) a single view is enough.

A first three-dimensional reconstitution was completed last year in collaboration with the CNRS experimental cytology center at Evry. The acquisition was made in the traditional manner, point by point, and the third dimension was computed by triangulation from points assumed to be homologous. For a global acquisition, it is necessary to smooth out curves by approximating digitized points. Segment processing, e.g. using the segments scanning the object horizontally, is then used instead of the usual image-processing algorithms (nibbling, extraction of skeletons, edges, etc.) involving a large number of pixels. The computations can then be made very fast on a PDP 11.

As far as 3D reconstitution proper is concerned, homologous points are interactively identified on a view in which hidden lines have been reproduced; drawing and correlation errors make the global solution mathematically unfeasible, and the drawing must therefore be corrected. The plane of symmetry is then defined by a least-square method: a first approximation of the resulting



Interpretation and Plotting Within a Few Tenths of a Second By the Forth Compiler of the CAD Team.

system (4n + 1 vectorial equations) has already provided a proof of feasibility in the form of a "three-views" diagram of the object. What remains to be done, therefore, is to refine the solution and impose constraints on corrections: number of inflection points, for instance, to avoid undulations.

Modeling and Animation

The object of this research is to make a methodological study of the basic functions of the digital geometry used in CAD and to break them down into optimized elementary operators (vectorial product, similarity, etc.).

The study also considers the part played by the host language, the creation of graphics software and of a CAD core on a microcomputer.

Application to animation: animation is increasingly used as a tool for comprehension. Computing a 2D image from a 3D model is very costly. One solution, then, involves direct interpolation from a few 2D images.

In order to study the impact and effectiveness of the host language, a decision was made to use Forth, a language with no linkage editor. A Forth compiler was therefore stored on a board built around a Motorola 68000, but without any operating system. A graphics mini-software was written (see attached test).

The methodological study started with intersection and clipping functions. The goal is to program algorithms operating on integers, including for the Bezier curves and the B-splines that were drawn in a few seconds. The Evry IUT, the INRIA [National Institute of Data-Processing and Automation Research] and the ENSTA [National Advanced School for Advanced Technology] have already expressed interest for this compiler.

Application to animation obviously started with the curves, but the lack of uniformity in the acquisition of the data-images is a problem, as it involves redefining homologous points. In some cases, the solution is to retain the curvilinear abscissa. Note the formalism similarity with 3D acquisition problems.

In 1984, interest focusses essentially on using a 68000 to model the universe of the walking robot of the Evry IUT (robotics laboratory).

As far as research commercialization and applications are concerned, the research carried out in this laboratory have produced the Euclid system. The researchers who were in charge of the project have left the laboratory to create the Datavision company, now a subsidiary of MATRA [Mechanics, Aviation and Traction company] and, indirectly, of Renault. In 1983, Datavision achieved sales of FF 80.3 million (an 11.2 percent increase over 1982). Exports accounted for 72 percent of its sales.

The "Spoken Communication" Team

This team, headed by the very dynamic Joseph Mariani, a CNRS researcher, is doing advanced research on voice recognition and synthesis. This research involves both basic research and more "practical" research which has led to advanced realizations at international level.

Spoken communication is a highly pluridisciplinary field in which all knowledge sources are closely interrelated. We can also say that speech research has as much to do with shape recognition as with artificial intelligence (expert system for sound-pattern recognition, elaboration of a cognitive model of lexical access, textual-data processing, etc.). The team also remains in close touch with D. Kayser's team at the LRI [Data-Processing Research Laboratory] and is jointly in charge of the "artificial intelligence" segment of the Paris-XI (Orsay) data-processing DEA.

To provide some structuring, the team's work is focussing on six main themes:

- analysis, synthesis and analysis-synthesis;
- phonetics, phonology, perception and invariance;
- global recognition;
- dialogue structures, ergonomics and cognitive process;
- spoken communication for textual-data processing;
- comprehension and generation of continuous speech.

As far as research implementation is concerned, it was no longer possible to devote too much time to discussions with the many industrial partners interested in vocal processes. As a result, the industrial interface is provided by Vecsys, a small to medium-size firm headquartered in Bievres and whose role is to monitor the progress of research and, as results become available, offer them to manufacturers or users. This enables researchers to devote less time to contract preparation and follow up, without disconnecting them from downstream applications of their research. We are now going to review very briefly the various orientations for the past year:

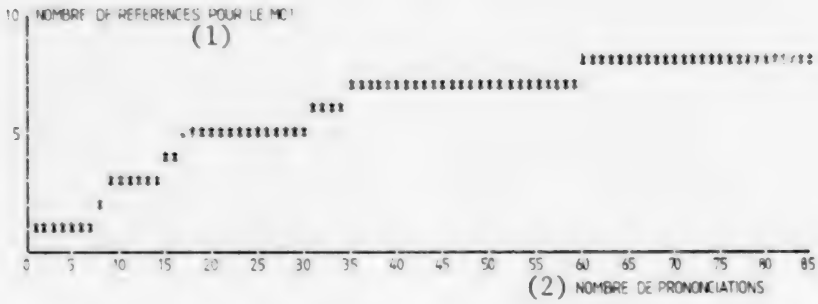
Very-Short-Term Analysis of Speech Signals

In any voice analysis, independently of the method used (FFT [expansion unknown], filter bank, etc.), a sampling period must be chosen during which the signal is considered to be stable. The signal is then processed according to parameters such as laryngeal frequency or the transfer function of the vocal conduit. Unfortunately, this method will ignore the rapid variations of certain basic parameters within the time window selected. On the other hand, if the window is excessively reduced (to a few milliseconds) the data obtained can no longer be processed. The approach suggested then attempts to describe the vocal signal as a sequence of events (glottal pulses, explosions, noise peaks) the linkings of which must be identified to return to phonetically relevant concepts (voicing, pitch, transition, etc.).

Recognition of Tone Languages

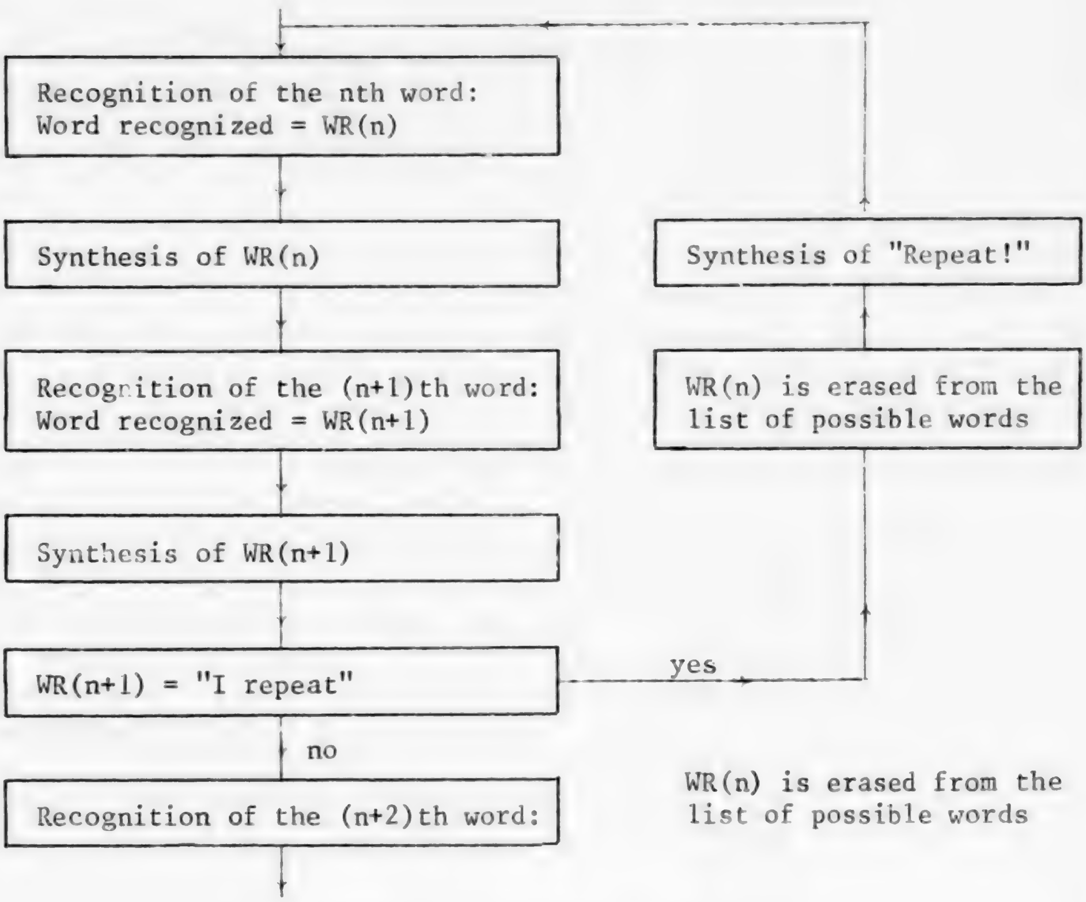
This applied research on the Pekingese and Thai languages aims at segmenting the speech signal into syllable-like units which are then partially charac-

Multi-Speaker Recognition ("Spoken Communication" Team)



Variation of the Number of References for "Three"

Key:
1. Number of references for the word
2. Number of pronunciations



Correction Strategy in Case of Error

terized so they can be recognized. Segmenting involves recognition of the syllabic core and/or recognition of syllable boundaries: a syllable-tone pairing is then made to reconstitute the rules according to which these tones are linked

[illegible]

The goal of this research is to identify factors characteristic of the individual and dialectal aspects of speech. It attempts to formalize the rules governing passage from one speaker to another one: this research orientation calls on disciplines such as acoustics, phonetics, phonology and perception. The method used is that of Klatt (of the MIT) which uses formants. Using this method, researchers formalize all parameters concerning the voices of several speakers (or several dialects of the same language) and try to identify the rules of passage from one voice or one dialect to another one in order to [illegible] that cannot be distinguished from the original.

Acoustic and Phonetic Analysis of Stable French Sounds

The goal here is to demonstrate that the spectrum of a vocal signal contains in itself enough information to characterize each vowel or stable phenomenon so that the identification of formants is not necessary.

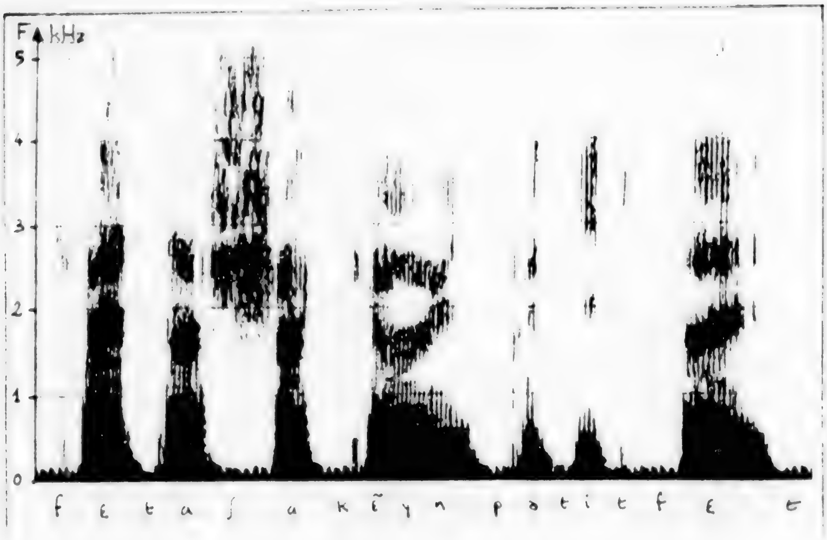
Global Multispeaker Recognition

The goal of this project is to recognize words in a vocabulary pronounced by any speaker. A first approach consists in using a vocabulary pronounced by a single speaker and a key sentence: any new speaker will pronounce the key sentence, and a polynomial transform is then applied to the signal obtained in order to extract the characteristics of the new speaker's voice. This is a difficult approach insofar as different transforms must be used, depending on the very nature of the sounds, which leads to a partition according to sound classes. A second approach requires the basic vocabulary to be pronounced by a large population: each different pronunciation of the same word is then considered as a new reference. Actually, it has been observed experimentally that the number of references for a given word remains stable around 10 or so which, for a 250-word vocabulary, gives 25,000 references, which is quite acceptable. Nevertheless, the crucial point remains the determination of the threshold from which a word may be considered as a new reference.

Mozart

A global recognition system for continuous speech: a board was actually made around an Intel iAPX 186. It achieves single-speaker recognition on the basis of a vocabulary of 200 words but in an illimited speech flow, or even the detection of single words in continuous speech. In addition, it can "learn," it takes into account syntactical constraints... and its use is being considered for the "air traffic aid" project of the Air Navigation Study Center (CENA).

Synthesis Close to the Original ("Spoken Communication" Team)



French Speaker: Original Sentence

Synthetic Sentence Nearly Indistinguishable From the Original

Prevert

A dynamic programming processor for speech recognition: the goal here is to produce a processor specialized in automatic speech-recognition. Recursive algorithms are used to find nearly optimum solutions to time-alignment and segmenting problems. The critical points are the computation of spectral distances and the resolution of local recursive equations. The system was completed and is now operating as a coprocessor to the Mozart system. Future development will probably involve making it as a very-large-scale integrated circuit.

A Speaker-Verification System

The system is designed to identify a speaker through global recognition of a "password to be supplied." The word pronounced will be compared with the reference and the system will then decide whether it identifies the speaker or not. However, this must be a multireference system reflecting voice alterations according to circumstances (fatigue, cold, etc.).

Spoken Communication With a Simulated Robotics System

The object is to produce a software interface managing a man-machine dialogue in the context of a task restricted to a limited field (handling of objects by a robot). The system must manage data exchanges with the voice terminal, translate the speaker's statements expressed in pseudo-natural language to transmit them in symbolic form to the data-processing system, and finally interpret the formal messages produced by the latter.

Recognition of Continuous Speech for Automatic Dictation

This show-and-teach recognition project consists of three parts: first, an automatic phonetic framing method using a large group of phonetic reals (close to 2,000), which make it possible to establish a correspondence between the theoretical contrasts of a text converted to phonetic elements with the contrasts of the average energy curve of the same text read aloud. Second, incremental classification makes it possible to regroup into classes the spectra of several phonemes, which yields a compression ratio of 8 or so (8,000 spectra giving 1,000 spectral types). Finally, recognition proper, which is not done continuously but around the extrema of the energy curve and transition center. The samples thus selected are compared to the references of phoneme classes.

Finally, we should mention the projected voice typewriter recognizing 135,000 pronounced words, i.e. approximately 270,000 written words (an, en, han, for instance, are pronounced in the same manner [in French]). To solve ambiguities, semantic analysis will have to be applied to the recognized text, in addition to syntactical analysis. This completes our brief review of some of the activities of the spoken communication group. When it is endowed with more efficient equipment and when the number of its full-time researchers is increased, it should be able to further extend the scope of its research.

Conclusion

Four or five issues of MICRO ET ROBOTS would still not provide an extensive coverage of this laboratory which is truly operating in an advanced sector and which, through its dynamism, has proved successful in commercializing its results. In addition, it has a privileged location, near the Paris-XI Faculty and near many laboratories of the CNRS and the CIRCE [expansion unknown] the computers of which (NAS 9080 and Amdahl V7) are used by the LIMSI simultaneously with the Cray-1 of the Polytechnic School at Palaiseau. We wish to thank the LIMSI people who accepted to meet with us and gave us all the information needed to write this article, in particular Mr Joseph Mariani for "spoken communication" and Mr Serge Koulondjoian for robotics.

Bibliography

The LIMSI is publishing so many articles, paper and internal memoranda that we cannot mention them all here. The reader will profitably consult the activity report of February 1984.

As far as robotics and "spoken communication" are concerned, two excellent books written in French are published by Editests:

- "Introduction a la Robotique," by Pierre Lopez and Jean-Numa Foulc, 1984.

- "Synthese, reconnaissance de la parole," by Marc Ferriti and Francois Cinare, 1983.

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BRIEFS

NEW BULL COMPUTER LINE--Koeln (cz)--The BULL group in Paris has announced the introduction of the new DPS 6 computer family. After this strategic product step, all the manufacturer's general-purpose computers have now been incorporated into the basic DPS concept (DPS = Distributed Processing System) and are generally suited for decentralized data processing. In architecture and applications features, the new system series conforms to the DPS 6 family in existence in the United States. Five models (DPS 6/210, 400, 450, 750 and 950) are offered. There is full software and peripherals compatibility to the current 6 series system. In addition to the five models, there is also the DPS 6/100, a microcomputer in the high performance class (previously the 6/10 system). This model is now the entry level for the new series. The DPS 6 series, made with components built with new technology, has storage ranging from 512KB to 16MB. With the inclusion of the DPS 6/100 super micro as the lowest level, internal computer performance ranges from the factor 0.4 to 40 (DPS 6/950). Most of the models can be upgraded to the next higher performance level on site. The GCOS 6 operating system can be used uniformly on all the computers in the new family. Also, UNIX can be run on the DPS 6/210, and MS-DOS and CP/M can be used on the DPS 6/100. [Text] [Leinfelden-Echterdingen DIE COMPUTER ZEITUNG in German 10 Oct 84 p 2] 8545

SEL FORMS NEW PARTNERSHIP--Stuttgart (vwd)--As of 1 Oct 84, Standard Elektrik Lorenz (SEL), Stuttgart, has assumed a 49-percent interest in Computertechnik Mueller GmbH (CTM), Konstanz. The Diehl-Gruppe, Nuernberg, retains its 51-percent share. A statement from SEL says this move is aimed at increasing SEL's market position in office communications by combining its competence in communications engineering with CTM's experience in office computers. [Text] [Leinfelden-Echterdingen DIE COMPUTER ZEITUNG in German 3 Oct 84 p 1] 8545

CSO: 3698/174

FACTORY AUTOMATION

FRENCH PANEL MAKES SPECIFIC PROPOSALS FOR ROBOTICS RESEARCH

[Excerpts from two-volume report prepared under the direction of M. Petiteau, J. F. Le Maitre, and P. J. Richard: "Mission Robotique." Vol 1, 160 pp, signed to press first quarter 1984; Vol 2, 226 pp, signed to press third quarter 1984]

Current State of French Robotics

Paris MISSION ROBOTIQUE 1 in French First Quarter 1984 pp 27-29

[Text] II.1 Foreword

Although because of the novelty of the products and the disparity of needs, it is difficult today to delimit the robotics sector and to precisely estimate the magnitude of its markets, the panel has found it useful to support its conclusions and guidelines with an analysis of current conditions. This analysis was based on fact finding tours, on commission reports, on publications, and especially on BIPE (Bureau for Economic Information and Forecasts) and DIEBOLD reports requested by CODIS (Steering Committee for the Development of Strategic Industries), as well as Y. Lasfargue's recent report presented to the Economic and Social Committee.

The figures used in the report generally refer to top of the line robots. They are statistically and comparatively representative of the situation in industrialized countries.

The panel does however emphasize that robotics and the automation of continuous and batch process production represents a broader market than the one for robots, a market that is generally not taken into consideration. Perirobotics, a potential outlet for conventional industries, doubles and even triples the markets of the robotics sector.

II.2 Diagnosis of the French Situation

The panel's diagnosis of the French situation is summarized by the following four points:

Adequate research level;
Recent market expansion;
Delicate and technologically dependent supply;
Lack of coordination and overall policy.

II.2.1 The level of research is satisfactory and research can continue to be competitive if greater efforts are made for researchers and budgets.

The French scientific potential, notably in matters of language, industrial software, industrial computers, and CAD (computer-aided design), is acknowledged by everyone, especially abroad. The Swedes, equipment experts, want to develop studies of a scientific nature in France.

Some foreign robots are equipped with technologies and components perfected in France, such as:

ASEA robots, equipped with CEM motors (700/year);

Japanese robots, equipped with welding heads whose electron beam source is supplied by the French.

II.2.2 Users are increasingly motivated and have become aware of the economic stakes; the welding industry for instance, which represents revenues of 2.1 billion francs (equivalent to one-half of the machine-tool market), could present interesting prospects.

II.2.3 French robot producers are faced with problems related to the size of their enterprises and of the domestic market. The revenues of leading French manufacturers are only about one-tenth those of the world's largest producer (30 MF--million francs--against 300 MF). They have difficulties with:

Controlling the importation which generally develops between enterprises of national scope and major foreign leaders in the field. This process is already under way at:

ARO and ESAB
OTC and ACB
Hitachi and Nauder
CGMS and Sankyo
Shin-Meiwa and Commercy
CEM and Yaskawa
Hitachi and SCEMI

Unfortunately, these examples very often are only trade agreements, and they should extend to licensing agreements that would allow technical cooperation and assure production on French territory.

Install a robotics sector which could offer competitive products. However, there does exist an interest on the part of American companies for French products (Renault, AKR).

II.2.4 Some of the links which weaken the industrial pyramid are:

Supplier disparity;

Financing;

Practical training in design and applications;

Structural lack of coordination and polarization for the efforts undertaken by the many public and private organizations active in robotics;

Failure to recognize present and future real needs on the basis of a "design-utilization" global approach system;

Lack of precise objectives for national and university-industry priority projects.

II.2.5 Diebold-CODIS Conclusions (1981)

The conclusions of the study "Robotics: Identification of Potential or Accessible Major Markets for Robotics by Type of Application in France," conducted at the request of CODIS, are significant. They define France's position in this field.

It is difficult to determine the robotics market:

New, actively developing technology;
Poor knowledge of inventory;
Recent, low inventory;
Incoherent definitions of the term robot;
Many and varied development hypotheses.

An analysis of recent robotics developments and manufacturer acceptance would indicate a rapid surge of robotics between 1983 and 1985.

Despite the good position of Sweden and Norway, Europe lags behind Japan and the United States.

Robotics in France, perceptively more advanced than in Great-Britain, is behind Germany and Italy at the industrial level.

The market for variable sequence robots (category 3) represents two and one-half the value of the market for advanced robots (higher categories).

The inventory of advanced robots should go from 2000 in 1985, to 6500 in 1990. It corresponds to one-fifth of the work stations capable of being robotized in 1990.

Number, Uses of Robots in France

Paris MISSION ROBOTIQUE 1 in French First Quarter 1984 pp 32-37

[Text] II.4 Forecasting and Statistical Factors for the Robot Industry

II.4.4 European Situation

	(A) Pays	(B) Production annuelle	(C) Production cumulée	(D) Production cumulée H de G>150kF(2)	(E) Valeur moyenne en kF	(F) Valeur annuelle en MF	(G) Valeur cumulée en MF
(H)	SCANDIN.	560	2060	1600	340 kF	190 MF	700 MF
(I)	RFA	1600	4800	1200	100 kF	160 MF	480 MF
(J)	ITALIE	300	3900	1000	150 kF	195 MF	585 MF
(K)	G.B.	80	300	30	80 kF	6,4 MF	24 MF
(L)	SUISSE	800	2400	—	20 kF	16 MF	48 MF
	FRANCE	1037	3815	687	180 kF	186 MF	620 MF
	EUROPE	5377	17275	4517	142 kF	753,4 MF	2457 MF

Key:
- (A) Country
- (B) Annual production (number of robots)
- (C) Cumulated production (number of robots)
- (D) Top of the line cumulated production > 150 kF. Japanese classification probably C+D+E
- (E) Average value in kF
- (F) Annual value in MF
- (G) Cumulated value in MF
- (H) Scandinavia
- (I) FRG
- (J) Italy
- (K) Great Britain
- (L) Switzerland

II.4.5 French Situation*

* Statistics on the number of robots in France on 31 December 1983, AXES ROBOTIQUES, No 4, January 1984

a. Distribution of Robots in France by Sector and Source

		France	(A) Autres pays d'Europe	(B) Reste du monde	Total	%
	Automobile	475	102	68	645	50,4
(C)	Mécanique	53	89	126	268	20,9
(D)	Plastique	28	11	1	40	3,1
(E)	Electrotechnique	10	17	15	42	3,3
(F)	Electronique	4	0	5	9	0,7
(G)	Métallurgie	5	21	67	93	7,3
(H)	Agro-alimentaire	0	3	39	42	3,3
(I)	Aéronautique	3	5	6	14	1,1
(J)	Electroménager	4	20	2	26	2,0
(K)	Sanitaire	1	14	0	15	1,2
(L)	Recherche	24	4	8	36	2,8
(M)	Autres	12	18	20	50	3,9
	Total	619	304	357	1.280	100,0
		619	661		1.280	

Key:
(A) Other European countries
(B) Rest of the world
(C) Mechanical
(D) Plastics
(E) Electrical
(F) Electronics
(G) Metallurgy
(H) Agricultural food products
(I) Aeronautics
(J) Household appliances
(K) Sanitation
(L) Research
(M) Others

b. Distribution of robots in France by Function and Source

		France	(A) Autres pays d'Europe	(B) Reste du monde	Total	%
(C)	Soudage par points	418	44	41	503	39,3
(D)	Soudage à l'arc	15	86	113	214	16,7
(E)	Pulvérisation	42	44	11	97	7,6
(F)	Assemblage	53	18	15	86	6,7
(G)	Manutention	74	51	158	284	22,1
(H)	Parachèvement	0	43	4	47	3,7
(I)	Collage	5	8	3	16	1,2
(J)	Autres	12	10	12	34	2,7
(K)	Totaux	619	304	357	1.280	100,0
		619	661		1.280	100,0
	%	48,3	23,8	27,9	100,0	

Key: (A) Other European countries
(B) Rest of the world
(C) Spot welding
(D) Arc welding
(E) Spraying
(F) Assembly
(G) Materials handling
(H) Finishing
(I) Bonding
(J) Others
(K) Totals

II.4.6 Proportion of French PMI (Small and Medium-Size Enterprises) Equipped With Automatic Manipulators

Total: 6 percent of 1900 enterprises surveyed in January 1981

By size:	10 to 49 employees	4 percent
	50 to 99 employees	8
	100 to 199 employees	12
	200 to 499 employees	21

By sectors:	Construction materials	9 percent
	Foundry and metal working	7
	Chemistry and associated industries	3
	Heavy mechanical industry	4
	Precision mechanical industry	6
	Electrical and associated construction	5
	Transportation equipment	7
	Textiles and clothing	7
	Miscellaneous industries	6
	Wood and furniture	9
	Paper and graphics industries	4
	Dairy and meat industries	
	Food products manufacturing	10

Note: The panel did not believe it necessary to perform these economic studies directly, and cites the latest figures provided by "Les Robots, Strategie Industrielle" by Thierry Lucotte and D. Leroux, Ed. Hermes

II.5 Penetration of Robotics in Various Sectors of the Manufacturing Industries

Percent of inventory > 4 percent

	Industries	Nombre d'emplois en % (A)	(B) % du parc de robots 1980	1990
(C)	Alimentation / boissons	3.7	Négligeable	2-3 %
(D)	Charbon, pétrole, chimie	2.4	Négligeable	
(E)	Métallurgie	1.2	Négligeable	28 %
(F)	Transformation de métaux	1.2	9 %	
(G)	Mécanique	4.7	8 %	
(H)	Transformation de métaux (semi-ouvrés)	2 à 3	1 à 2 %	19 %
(I)	Instrumentation	.7	Négligeable	
(J)	Industrie électrique	2.1	6 %	
(K)	Electronique	1.7	5 %	
(L)	Construction navale	.9	Négligeable	38 %
(M)	Automobile	2.7	58 %	
(N)	Aérospatiale	.8	1 %	
(O)	Cycle, motocycle autres transports	.9	2 %	
(P)	Outillage manuel léger	.5	< 1 %	12 à 13 %
(Q)	Textile, cuir, confection	5.2	Négligeable	
(R)	Céramique, matériaux	1.4	5 %	
(S)	Bois et ameublement	1.3	> 1 %	
(T)	Papier et imprimerie	2.7	Négligeable	
(U)	Caoutchouc, plastique	1.3	4 %	
(V)	Autres industries de transformation	0.5	Négligeable	

Key:
(A) Number of jobs (in percent)
(B) Percent of robot inventory
(C) Food/drink
(D) Coal, oil, chemistry
(E) Metallurgy
(F) Metal processing
(G) Mechanical
(H) Metal processing (semi-finished)

(I) Instrumentation
(J) Electrical industry
(K) Electronics
(L) Ship construction
(M) Automobile
(N) Aerospace
(O) Bicycles, motorcycles, and other transportation
(P) Light hand tools
(Q) Textiles, leather, garments
(R) Ceramics, construction materials
(S) Wood and furniture
(T) Paper and printing
(U) Rubber, plastics
(V) Other processing industries

Negligeable = negligible

Percentage of jobs in examined sectors as a function of the active population in industrial sectors.

Table based on Diebold information.

These estimates of the industrial robot inventory and its geographic distribution among the major industrialized countries, make it possible to understand the present gap and delay of the French industry, in the context of international competition. This information must be used as an overall indicator, to be examined and adapted as a function of activity levels in each sector (automobile, aeronautics, mechanical, electronic), as well as for each type of robot.

II.6 Estimate of Demand and Growth Rate

France is in a waiting situation, and Diebold forecasts the following growth rates:

From 1980 to 1985, 30 percent per year for Europe and 16 percent per year for France;
From 1985 to 1990, 39 percent per year for Europe and 64 percent per year for France.

The market explosion should follow the entry into robotics of a new generation of manufacturers in various activities, which will compete against the monopoly of the major machine-tool builders. These new entrants will play a double role: first of all, equipment prices will be reduced, and secondly, the market will develop quantitatively by a factor of eight through more sectorial and localized customer service.

II.7 French Market

The French market for top of the line robots has been estimated by the Ministry of Industry at:

About 100 to 150 MF in 1980;
About 150 to 200 MF in 1981;

to which should be added the perirobotics markets, which in the absence of accurate information are evaluated at two or three times these figures. Importations represent 50 to 60 percent of the total, and are primarily of American and Japanese origin. This situation raises many problems for national independence and control of industrial processes. Many small manufacturers and projects under development have been surveyed by the panel. These estimates describe the situation of French enterprises.

II.8 Industrial Structure - Critical Size

It is important to note that the largest producer of robots in France is the Renault group, through its ACMA subsidiary. In all countries, the automobile industry is the one which has played a crucial role in the development of robotics; this manufacturer-user link can be formed through affiliation (Renault with ACMA, Fiat with COMAU, and Volkswagen with 450 robots installed at the end of 1981) or through preferential commercial arrangements. At present, two development channels must be implemented simultaneously:

II.8.1 To meet the competition of multinational foreign companies (especially American and North European), it appears that the enterprises in a position to resist dependency on foreign goods are essentially those which are supported by a multinational industrial group, or those which have a preferential relationship with a powerful national industrial group.

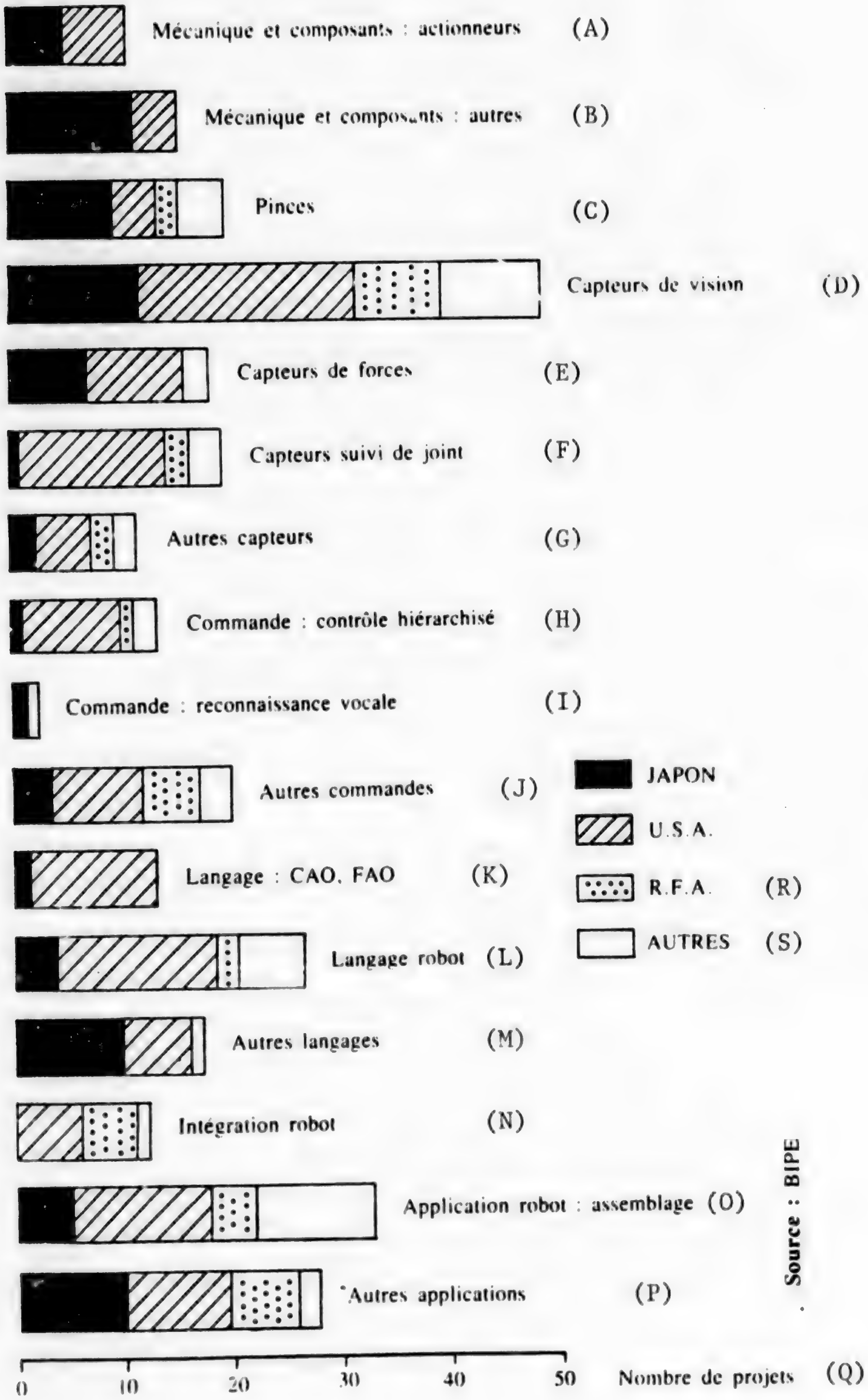
No French company currently has the critical size required by the many world manufacturers positioned on the international market, such as Cincinatti Milacron, Unimation, Fanuc, ASEA, and so on. But some of the large French industrial groups could play a serious role (Renault, Matra, CGE, CEA). The necessary investments are of the order of a billion francs for a production of this magnitude in 1985.

II.8.2 Much more rapid because it does not require a major strategic decision, is to encourage the formation of a network of small, high performance enterprises in well identified market slots. Already, some companies like AKR (subsidiary of AOIP Kremlin), Sormel (Matra subsidiary), SCEMI (CEM--Electro-Mecanique Company subsidiary), Industria, Pharemme, AID, Bornelec, are on the market for less than 100 million francs. Through the creation of new enterprises, our goal should be to bring this capability to several hundred million francs in the next three years.

Location of Robotics Labs in France

Paris MISSION ROBOTIQUE 1 in French First Quarter 1984 pp 42-43

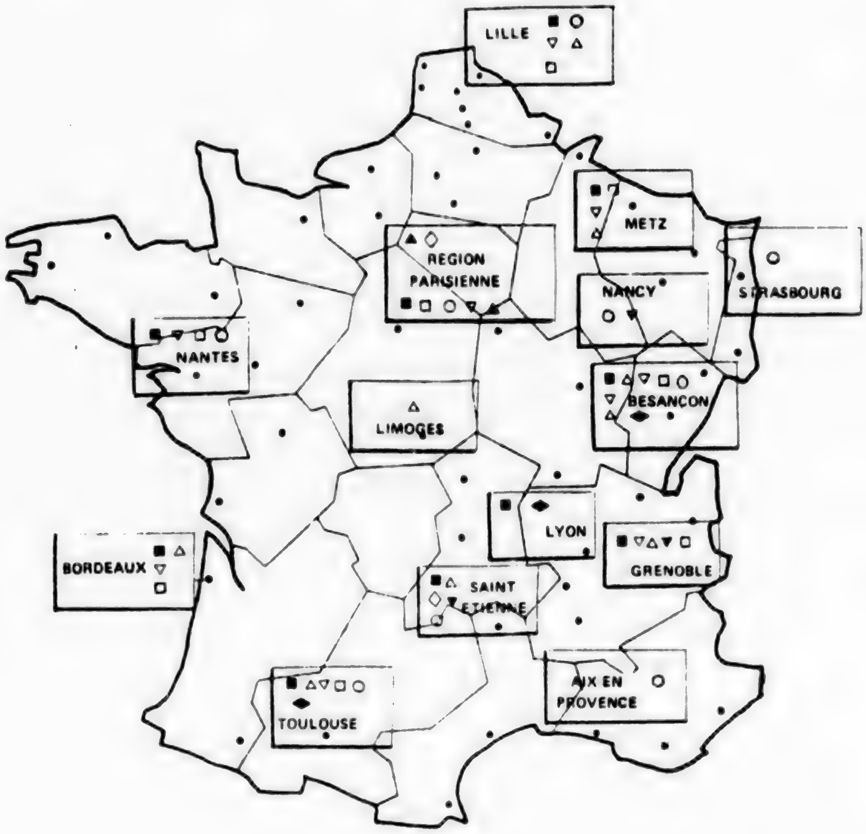
[Text] II.3 Number of R&D Robotics Projects by Fields and by Countries



Key on following page

Key:
(A) Mechanical devices and components: actuators
(B) Mechanical devices and components: others
(C) Grippers
(D) Visual sensors
(E) Stress sensors
(F) Joint tracking sensors
(G) Other sensors
(H) Command: hierarchic control
(I) Command: voice recognition
(J) Other commands
(K) Language: CAD, CAM
(L) Robot language
(M) Other languages
(N) Robot integration
(O) Robot application: assembly
(P) Other applications
(Q) Number of projects
(R) FRG
(S) Others

II.14 Map of Robotics Hubs and Regional Centers



(A) ■ Centres existants
(B) ▲ Centres en cours de formation ou proposition de création
(C) △ Industriels
(D) ▽ Laboratoires publics
(E) ◆ Ecoles d'ingénieurs (avec option robotique)
(F) ▼ Centre technique
(G) ○ Antenne technique ADEPA (implantée ou en cours d'implantation)
(H) ◇ Centre spécialisé en machine outil (Seine-St Denis, St Etienne)
(I) □ Action de formation

Key:
- (A) Existing centers
- (B) Centers being formed or proposed
- (C) Manufacturers
- (D) Public laboratories
- (E) Engineering schools (with robotics option)
- (F) Technical center
- (G) ADEPA (Association for the Development of Automated Production) technical station (installed or being installed)
- (H) Center specialized in machine-tools (Seine-St Denis, St Etienne)
- (I) Training activity

Recommendations for Research in Certain Components

Paris MISSION ROBOTIQUE 1 in French First Quarter 1984 pp 51-79

[Text] III.2 Sensors

1) Definition of the Sector

The results obtained with any automatic system, reflect at best the performance of the sensors that control the system.

Not only does robotics not escape the rule, but it actually generates new problems whose solutions determine on one hand, the industrialization possibilities for first generation robots, and above all on the other hand, the implementation of particularly sophisticated structures: machines designed and manufactured not to be constantly "manpowered" by an operator, but rather directed by the latter through the intermediary of a microprocessor (second generation).

It is clear that the use of sensors is intimately connected with the imperative that exists at the national level, to develop automatic production lines to the utmost and in the largest possible number of industries. The technologic evolution sometimes implied by such an operation will not even be adequate for some enterprises; by necessity, lest they disappear, or simply to survive, they will have to take one further step and use robotic techniques.

2) France's Strengths and Handicaps

In Research

Whether public or private, research does not have properly structured teams that can be designated as "hubs" of activities oriented toward stages of development in robotics sensors.

The more's the pity, since the only activity of international standing is precisely and solely the one carried out by scientific and technical research laboratories.

Our strengths are nevertheless considerable, because our level of knowledge is truly comparable to that of our foreign colleagues. We are indeed perfectly capable of defining the functions that will have to be performed so that short and intermediate term industrial development will correspond to the production of "pertinent" (or third generation) systems, capable not only of impacting the foreign penetration of these products in France, but also and especially, of affecting the competition.

Unfortunately, the handicaps are fierce, and all the more difficult to overcome since most of them are not of a scientific nature.

In our public laboratories, there are today no structures that truly allow a rapid transfer of knowledge. The study and construction of a sensor, especially one specific to robotics technology, represents a multidisciplinary activity of obvious magnitude, and the "assembly" of the parameters necessary for its design (and of its associated systems) is made more difficult by the fact that one naturally wishes to succeed "before" potential users have clearly formulated their wishes (if one does it "afterwards" it is already too late!).

This concept of systems design, together with the absolute necessity of working with short deadlines, raises at present a number of problems for research.

In Industry

To simplify, we can consider that two large families of sensors exist in robotics:

1) Those designed to control the operation of the elements that compose the operating machine (manipulator arms, mobile robots, and so on), which are the internal sensors;

2) Those designed for using the machine with respect to its environment, requiring the detection and formulation of information that is much more difficult to manage, but which must be obtained in order to achieve innovative methods, a fundamental condition for entering the international market.

The national industry has all the necessary resources to meet the need for internal sensors. However, activities remain scattered and as a rule, manufacturers have relatively little incentive to make the effort to adapt their known technologies to the specific area of robotics.

This problem nevertheless seems easy to solve since an evident desire to participate in this growth clearly does exist, and since an information effort would probably be sufficient to accelerate a movement which is already started.

By contrast, the problem is greatly different for sensors that could be called "environmental," and significant efforts will have to be made in this domain to convince industry to invest, to take risks, and to make quick commitments to difficult pursuits; that is, to ask it to do what it generally undertakes only with much deliberation, much concern (probably well founded!), much time, much too much time.

3) Proposed Actions

It seems futile in this editorial project, to draw a complete (?) list of the sensors that should be modified, adapted, or created, without examining a modicum of the scientific and technical justifications indispensible to any dialog among specialists.

Our objective will therefore be limited to an enumeration with a few examples, of the areas in which a particular effort appears indispensible, even though the information collected nationally and internationally is for the time being still quite insufficient.

Needs should obviously be surveyed before any measures are taken.

This problem is not easy to solve. What needs? For sensors of course, and for a robot. But a robot meant to do what? Because you cannot do "robotics" as you might do "electronics."

In fact, we should attempt to define (like the Americans and the Japanese), if not a "federating topic" at least a "federating robot" obviously, cleverly (and silently) defined to focus all efforts around an objective which everyone could use as a foil and adapt as well as possible to the capabilities of each enterprise. This would give rise to other structures, rightly or wrongly considered as being more useful, more ingenious, and so on, but if the "model" is well chosen, the system would be primed.

In Technology

It is therefore indispensible to generate a structure whose form need not be defined, in collaboration with component specialists, so as to know whether or not a solution to this problem is expected. If yes, when? And if not, then a "sub-contracting" organization must be rapidly established, perhaps in terms of a European agreemen. This might enable us to improve our effectiveness against the United States or Japan.

In technology, several other fields appear particularly interesting:

Optical Fibers

Industrial robotics is generally used in difficult environments (electrical, electromagnetic, atmospheric pollution, and so on). The utilization of optical fibers must create projects for sensors that use the fibers not only as detectors, but also as simple means to transmit information to a microprocessor (without addressing the issue of telecommunications!!).

Ultrasonics

Too little work is being done in France in this area. The work has to be done on all fronts, in materials, in understanding the physical phenomena and their applications (integrated technology or not), in measuring such diverse parameters as flow, proximity, shape, and so on.

Low Power Laser Sources (Integrated!)

It seems perfectly realistic for instance, to imagine that a precisely assembled sensor could be designed by appropriately using laser sources on the gripping tool, not to mention a large number of applications in telemetry, shape recognition, and so on.

Shape Recognition Sensors (Other Than Lasers and Ultrasonics)

Visual: maximum development of CCD (charge-coupled device) camera techniques, by adapting them to the resolutions necessary and sufficient for robotics.

Tactile: both to improve the performance of gripping tools, as well as to simply recognize shapes by their optical, pneumatic, electrical, and other imprint (artificial leather, PVF2 system).

4) Summary of Financial Outlay for Priority Actions

Sensor field

Investment in heavy equipment	Who does what in the integration of sensors in electronics
Permanent research teams	10 men
Concerted actions	
"Internal" sensors	3 MF in research/year/3 years 40 MF in development/year/3 years
Environmental sensors	
Visual	4 MF
Laser-ultrasonics	3 MF 5 MF/year/3 years
Assembly RF	3 MF
Development	15 MF/year/3 years

III.3 Hydraulic Motors

2) Present Situation

French hydraulics show a heavy deficit and little innovation, particularly in fixed industrial applications. (See for instance SIA, INGENIEURS DE L'AUTOMOBILE, No 14, October 1981, "Situation of French Hydraulics" by Pierre Lecard, president of the Union of Hydraulic and Pneumatic Transmission Manufacturers).

By contrast, the aerospace-weapons sector on one hand, and to a lesser extent, the sector of industrial mobile applications on the other hand, demonstrate vitality and international competitiveness.

Consequently, the actions to be taken will have to be carefully selected (sector in which the French are present or new sectors) and carefully staffed (industrialist or structure leader).

3) Proposed Actions (see table)

Given this table and the previous comments, four devices or families of devices have been selected to provide support action:

An actuator: screw actuator
Two control devices: a servovalve and a modular component
A component for hydraulic power: vane pump

Hydraulic Components

	(A) CONSTITUANTS		(B) Avantages principaux	(C) Inconvénients principaux	(D) Existence: sur le marché	en développem[t]	en recherche	(E) Problème à résoudre
(X) ACTIONNEURS	Moteurs hydrauliques (A1)	à pistons	existent et sont au point (B1)	. Coût . nécessité d'un réducteur (C1)	OUI en France et à l'étranger	? (D1)	?	. Intégration des capteurs et des organes hydrauliques de sécurité . Le Réducteur (E1)
		à engrenages	devraient être moins chers	forte fuite interne	NON	?	?	Mise au point industrielle (* les problèmes ci-dessus)
	Vérins rotatifs (A2)		parfaite adaptation à la fonction (pas de réducteur)	Difficulté de mise au point et fabrication	NON	à l'étranger (GOD-RFA)	OUI (Besançon ...)	Etude en France à encourager (B2,C2,D2,E2)
	Vérins linéaires (A3)		bonne adaptation à la fonction (pas de réducteur)	. Masse . Mouvements sortie au-delà de 70-80°	OUI France et étranger	(B3,C3,D3)		Intégration (cf. ligne 1) Cinématique pour sortie à grand débattement angulaire (E3)
(Y) ORGANES DE REGULATION	Servovalves (A4)	classiques	adaptation à la fonction (B4)	. Prix . Sensibilité à la pollution	surtout à l'étranger	?	?	Etude et production en France à encourager si l'étude du marché est favorable (E4)
		à l'étage	devraient être moins chères et moins fragiles	. Masse (C4)	NON (D4)	En France et à l'étranger pour applications aérospatiales		
		numériques		. Problèmes de commande	NON			
(Z) GENERATIONS	Organes annexes (A5) (composants en cartouches)		Gros avantages de la présentation en cartouche	(B5)	à l'étranger seulement	(D5)	?	Retard français à combler impérativement (E5)
	Sources de fluide sous pression (A6)		existent et sont au point (B6)		OUI France et étranger	(D6)	—	Pas de producteurs français de pompes à palettes (E6)
	Tuyauterie (A7)		existent (B7)	. Masse . Raideur (C7)	OUI France et étranger (D7)	?	?	Améliorations possibles (allègement) (E7)

Key on following page

Key: (A) Components
(B) Major advantages
(C) Major disadvantages
(D) Existence: on the market
under development
in research
(E) Problem to be solved
(X) Actuators
(Y) Control devices
(Z) Generations
(A1) Hydraulic motors: piston
gear
(B1) Exist and are perfected
Should be less expensive
(C1) Cost; need for reducer
Strong internal leakage
(D1) Yes, in France and abroad ? ?
No ? ?
(E1) Integration of sensors and safety hydraulic devices; reducer
Industrial development (problems as above)
(A2) Screw actuators
(B2) Perfect adaptation to function (no reducer)
(C2) Difficult to perfect and manufacture
(D2) No Abroad (GOD-FRG) Yes (Besancon ...)
(E2) Study in France to be encouraged
(A3) Linear actuators
(B3) Good adaptation to function (no reducer)
(C3) Weight Motion extension beyond 70-80 degrees
(D3) Yes, France and abroad
(E3) Integration (see line 1). Extension kinematics for large angles
(A4) Servovalves: conventional
stepped
digital
(B4) Adaptation to function
Should be less expensive and less fragile
(C4) Price Sensitivity to pollution
Weight
Control problems
(D4) Especially abroad ? ?
No In France and abroad for space applications
No In France and abroad for space applications
(E4) Encourage study and production in France if market study is favorable
(A5) Associated devices (modular components)
(B5) Great advantage of modular presentation
(D5) Only abroad ? ?
(E5) French delay must absolutely be eliminated
(A6) Sources of pressurized fluid
(B6) Exist and are perfected
(D6) Yes in France and abroad -- --

(E6) No French producers of vane pumps
(A7) Piping
(B7) Exists
(C7) Weight Rigidity
(D7) France and abroad ? ?
(E7) Possible improvements (lighter weight)

Screw Actuator

The screw actuator, that is, an angular actuator whose motion is limited to a fraction of a revolution, is particularly well adapted to robotics requirements:

Better than a hydraulic piston or gear motor because unlike them, it does not need a mechanical reducer (it provides high torque directly);

Better than a linear actuator, which is always difficult to use for rotational movements greater than 80-90 degrees.

But to our knowledge, this type of actuator is not yet produced industrially.

Significant efforts appear to be underway in FRG.

Interesting efforts, but with limited resources, are being pursued in France (University of Besancon, for instance).

The framework for a team exists.

To develop a product specifically for robotics, it would be advisable to:

Support research: estimated effort of 2 MF/year for three years;

Encourage the development of a series of actuators: estimated effort of 2 MF for the first year, 4 MF for the second year, and 6 MF for the third year.

Servovalve

Capturing a portion of the conventional servovalve market is a financially onerous and always risky operation.

But at the same time, new servovalves are being created:

On one hand, servovalves with a single hydraulic stage (called direct valves in the United States), more primitive, less sensitive to pollution, and made possible by progress in power electronics;

On the other hand, digital servovalves, in which the French aerospace hydraulic industry is in a leading position.

It is clearly the development of these new servovalves that should be supported with the following means:

Research: 2 MF/year for three years
Development: 2 MF for the first year
4 MF for the second year
6 MF for the third year.

It should be noted that the resulting products could find applications outside of robotics.

Modular Components

In recent years, foreign manufacturers have offered components or component elements (elementary functions) in the form of standard plug-in modules that would allow some system optimization (erector set installation).

To our knowledge, no French manufacturer has entered this field.

It should be noted that the area of applications would be far wider than the hydraulics domain.

It therefore appears that the development effort should be undertaken by another structure.

Vane Pump

The situation is entirely similar to the one above, concerning modular components. The necessary effort should also be undertaken by another structure.

4) Financial Summary

Action		Estimate (MF)
Screw actuator:	research	2 - 2 - 2
	development	2 - 4 - 6
New servovalves:	research	2 - 2 - 2
	development	2 - 4 - 6
Modular components:	development	not part of robotics
Vane pumps:	development	not part of robotics
Totals		8 - 12 - 16
		36

III.4 Electric Motors

1) Definition of the Sector

This sector concerns the electric motorization of programmable production machines and equipment:

All types of industrial robots;
Transfer machines, machine-tools;
Special machines (including assembly);
Material handling (storage, carts, self-propelled devices, and so on).

2) Description of Present Situation

This situation has been the subject of several analyses which need not be covered here. Their major points are:

In this area, French research and industry have the essential experience basis. As a whole however, France's penetration in various segments of the market is not commensurate with this experience.

Moreover, it does not appear realistic to plan an industrial offensive on all fronts, given the large short-term efforts being made by leading foreign enterprises with existing products, and with the development of these products.

France's option would rather be to concentrate research and industrial forces on potential products resulting from the foreseeable growth in industrial automation.

In research, it will therefore be a matter of doubling the potential in these strong market slots within three years, slots in which robots are only sub-assemblies.

3) Proposed Actions

General Actions

They are summarized in the following table.

Basic Research for the Development of new Motors and Actuators

Total général : 120 MF sur 3 ans (W)	Moteur (X)	Electronique de puissance (Y)	Logique (Z)
1 Approche intégré (Moteur + électronique puissance + logique)	(A) - Comportement en transitoires rapides Rendement - Inertie propre entraînée **60 MF**	Protections aspects thermiques (Approche produit, donc vue en général). (A1)	Adaptations aux inertes (A2)
2 Recherche puissance massique 0,1 KW/KG 0,3 KW/KG a 3000 T/min. Ondulation de couple, vitesse variable, résolution.	(B) - Calcul des champs - Thermique - Métallurgie **6 MF**	(C) Structure des circuits de puissance Réduction de coût en composants actifs et passifs. **21,6 MF**	(D) Logiciels de commande optimale **9,6 MF**
3 Maintenance tenue à l'environnement	(E) - Suppression contacts glissants - Isolants **6 MF**	(F) Aspects thermiques (approfondi par secteur utilisateur). Protection **9,6 MF**	Sécurité (F1)
	(G) - Actionneurs sans réducteurs **7,2 MF**	Cinétiques linéaires ou rotatives obtenues de façon directe	

Key on following page

Key: (W) Overall total: 120 MF over 3 years
(X) Motor
(Y) Power electronics
(Z) Logic
(1) Integrated approach (motor + power electronics + logic)
(2) Power/weight research, 0.1 KW/KG 0.3 KW/KG at 3000 rpm
Torque modulation, variable speed, resolution
(3) Maintenance, tolerance to environment
(A) Response to rapid transients Efficiency
Inertia: self, load -- 60 MF
(A1) Protection, thermal features (product approach, hence overall view)
(A2) Adaptation to static conditions
(B) Field calculations Thermal Metallurgical -- 6 MF
(C) Structure of power circuits
Cost reduction for active and passive components -- 21.6 MF
(D) Optimum control software -- 9.6 MF
(E) Sliding contact suppression Insulators -- 6 MF
(F) Thermal features (by user sector) Protection -- 9.6 MF
(F1) Safety
(G) Actuators without reducers Rotary or linear kinetics obtained directly -- 7.2 MF

Actions Specifically for Robotics

The electric motor market for robots is too small to justify autonomous action. The "robot" criterion will intervene for the following specifications:

Reduction of axis motorization costs: from 20 KF to 10 KF per axis, with a 200 percent performance improvement (power/weight, and so on). This point calls particularly for the integrated approach (A) indicated in the table;

Actuators without reducers, linear ones in particular.

4) Summary of Financial Effort

Given the various parameters, the effort was estimated at 120 MF (HT -- before taxes) over three years, with the following distribution:

Three-Year Plan (120 MF)

Heavy equipment investment: 25-30 MF (HT)
Investments for research in competing sectors.

Permanent research teams and joint actions: 80 MF (HT)
Operating and employment costs for doubling the research potential of French enterprises in three years;
Hiring 160 researchers; 40 during the first year and 60 for each of the next two years.

Research orientation in public laboratories: 10-15 MF (HT)
Financing to fulfill the potential of public research laboratories.

Development cost:
This cost depends on the nature and magnitude of the industrial equipment to be installed, and consequently both on a precise definition of the objectives being sought, and on an analysis of the present situation. This item therefore depends mostly on company strategies, and will be supported by them. It cannot be evaluated here in the light of present knowledge.

Miscellaneous financial aids:
Several hundreds KF will have to be devoted to the financing of economic studies and to the work needed to formulate the final program.

State financing:
The estimated 120 MF will be financed partially by the government as follows: 50 percent for items 1 and 2
100 percent for item 3
for a total of 66-70 MF over three years calculated as follows:
Items 1 and 2: 80 x 0.5 + (25 to 30) x 0.5
Item 3: (15 to 10) x 1
Total for the three items equal to 120 MF.

III.5 Pneumatic Motors

3) Present Situation

In France, research teams have started to explore digital actuators, diaphragm actuators (for small displacements), inflatable actuators (prostheses), and servoactuators.

A significant research effort remains to be made in this domain, in which we have acknowledged competence both for pneumatic actuators and for pneumatic logic and in fluidics. At the same time, we are rather weak in terms of control units (servovalves), interfaces (electropneumatic relays), and sensors. In order to be in a position to respond rapidly to a market demand which is sure to arise if announced performances are confirmed, company research should be supported and new research initiated.

4) Summary of Necessary Actions

Technical Actions -- Evaluation of Current State of the Art

Census of available technology and its performance level:
For actuators
For robots.

Forecast study of pneumatic and hybrid solutions:
- Examine possible solutions for fully pneumatic robots, and for robots that would include other types of actuators
- Evaluate potential application niches
- Census of current capabilities for research and development.

Specific research on actuators:
- Two approaches must be explored simultaneously:
  - Step by step rotary motor including soud proofing
  - Programmable linear actuator in several versions:
    - Positioner
    - Flexible actuator
    - Digital actuator.

Electronic pneumatic interface:
- Integration of microprocessor in controller.

Necessary Financial Effort

	Amount (MF)	Time
Evaluation of current technology	0.5	1 year
Prospective study of pneumatic and hybrid	1	3 years
Actuator research	2/year	3 years

III.6 Structures -- Kinematics -- Peripherals

1) Definition of Sector

This field covers all robot hardware except for sensors, information processing units, and actuators; it consists primarily of:

Architectural components of load bearing systems:
- Segments, articulations, and motion transmission parts, that are not specific to robotics, but must satisfy strict specifications for application in this area, where they determine the mechanical performance of robots.

Effectors
- These end tools,which enable the execution of specific actual tasks, are essential for the use of robots and often constitute true systems with their own sensors and motions.

Peripherals
- These ancillary systems facilitate:
  - Either man-robot dialog (information peripherals such as syntaxers, indicators, master manipulators, and so on);
  - Or robot-environment interaction (operational peripherals such as supply, positioning, storage systems, and so on);

From an economic standpoint it can be said that in order of magnitude (varies according to size and area of application):

Hardware represents at least 50 percent of a robot's price;
Effectors and peripherals represent about 50 percent of the price of a robotized work station.

2) Present Situation

Industry

Excellent level of mechanical (load bearing) construction;

Excessively high costs (top of the line);

Solutions not optimized for areas of application;

Very inadequate development of effectors and peripherals, which are however essential for users, and constitute a market that is more open than that of load bearers.

Research

Large quantitative imbalance in hardware and software, despite the positive encouragement represented by the ARA (Automation and Advanced Robotics) Mechanics and Technology hub;

Lack of interest in robotics on the part of scientists specializing in mechanics, who view it as a simple application of mechanical technologies;

Limitation of the majority of automation specialists exclusively to electrical engineering and computer technology problems, as a result of their origin.

3) Proposed Actions

Specific Actions

Develop in France, permanent robotics engineering teams endowed with sufficient human and material resources (critical mass);

Joint research actions (enterprises + laboratories), in robotics effectors and perirobotics (primarily operational peripherals);

Support the initial and research training of "new automation specialists" with a strong mechanical engineering background.

General Actions

Support actions that go beyond the strict confines of automation and robotics, but that are essential for industrial growth in this field:

Packaging of mechanical components (products);

Machine technology (components);

Machine architecture (design);

Production methods (engineering).

These actions should occur at the level of research and development, as well as of operations and industrial promotion.

It would also be appropriate to encourage in the name of robotics, a corresponding education for the initial training of advanced level engineers and technicians.

4) Financial Summary

Nature of proposed actions	Estimate
Investment in heavy research equipment	5 MF
Permanent research teams: researchers	12 persons
Permanent research teams: ITA (Administrative Engineers and Technicians)	12 persons
Joint actions	
Effectors	2 - 2 - 2 MF
Peripherals	1 - 1 - 1 MF
Machine technology	
Machine architecture	
Production methods	
Preconditioning	
Development	5 - 10 - 15 MF
Aid for company formation	2 - 5 - 5 MF
Support to laboratories and research information (theses)	12 persons

III.7 Computer Technology

2) Present Situation in France

France's situation in computer technology for automation is essentially the same as for computer technology in general. It can be summarized as follows:

Excellent research teams for theory and software;
Good level of engineering industrialists, particularly for software;
Strong foreign dependence (the United States and recently, Japan) for equipment.

Since 1975, research teams in the public sector have benefited from a sustained orientation toward robotics (Spartacus project, DGRST--General Delegation for Scientific and Technical Research, ARA project) which have brought more than 150 researchers into this field. France thus has a talent pool in state jobs without equal in the world. The other side of the coin is a certain lack of connection with the industrial sector, or more exactly with real needs.

Encouraged by the government, some manufacturers have developed collaborations with public research centers, but often with the primary motivation of possible government financing. The majority of the potential industrial users have not yet developed the habit of turning to public laboratories to find the expertise they may lack, and to pay a fair price for it (or even to pay for it only as a symbolic gesture).

The only group that can be mentioned in industrial research is the RNUR (National Management of Renault Plants) team, which thanks to very large manpower and equipment resources was able to develop one of the best teams in the world. It should be noted that the financing of such research is only in response to a strategic wish to control production facilities, since robotics activity as such builds up a strong deficit.

The strong points of French research are:

Shape recognition (two and three dimensions);
Robot programming languages;
Remote manipulation;
Sensors (contact, touch, proximity, stress);
Dynamic control.

Its weaknesses are primarily:

Computer technology elements in general as well as components specific to robotics;
Specialized architectures (image processing, control);
Definition and design of specialized circuits;
Links between mechanical technology and information processing.

The specialty of robotics engineering is at its inception, and only the large automobile and aircraft manufacturers are relatively well equipped in this area. However, faced with the potential start of a strong demand, SSCI's (companies for service and consultation in computer technology) are seeking to fill the niche by offering their knowledge. Their competence is of world class in software development, particularly for large real time systems such as can be found in automated production shops. Some of these SSCI's have just begun writing software specifically for robotics, but basing themselves solely on the hopes of future marketing.

Compared to the engineers, French manufacturers find it difficult to find their own spot, their abilities often being the same as those of the engineers (good competence in studies, particularly in software), but their customers are not ready to pay for the machine plus the specific study for its utilization. But despite a domestic demand which is still very weak, French manufacturers have been able to develop world class machines, particularly in terms of computer technology, but maybe at a price slightly higher than the competition.

This is likely due to France's dependency for components. Most of the major components of a robot (computerization as well as as power, sensors, hydraulic components) are imported, whereas they are manufactured by the same unit in the case of foreign competitiors. This dependency not only weighs down production costs, but in the near future also threatens a technologic gap for French manufacturers, if their competitiors have components with an advance of one or two years (as we have already indicated, the lifetime of a robot computer system is about five years).

3) Proposed Actions

Recognizing that it is preferable to strengthen France's area of expertise while trying to retain technologic independence, the panel has issued the following recommendations for studying, developing, and disseminating the computer technology necessary for automated production:

Public Laboratories

To maintain their competence, the laboratories need world class working and research equipment. Past policy has led to under-equipment (particularly in terms of the mediocre French equipment imposed upon them) which is beginning to harm the research effort.

The laboratories need better working tools as well as advanced experimental equipment.

An overall equipment policy must be implemented with the intent to assure good inter-laboratory coordination for facilitating exchanges of knowledge. (An inter-computer network for research is necessary).

To upgrade the computer equipment in public laboratories, an immediate effort of 30 MF is a minimum (current expenses of 5 MF/year with restricted choices and lack of coordination).

Computer Equipment: 30 MF

The human resources, which are already very large (about 100 researchers), could be strengthened with a more active participation from industrialists, particularly on the following topics (the first figure indicates the number of researchers wanted in that field; the second--in parantheses--indicates the current situation):

Second-third generation robotics language. France must maintain its lead in this area, which is also one of our strong industrial points: 3 persons (15);

Specific sensor software (vision, touch, stress) and interaction with basic languages: 20 persons (2);

Liaison between CAD (computer-aided design) and CAM (computer-aided manufacturing). Automatic program generation: 30 persons (13);

Technical data base for automatic production: 20 persons (2);

Specialized robotics architectures: 20 persons (5);

Definition of specialized functions for VLSI integration: 12 persons (0).

Additional human resources: 95 researchers

Moreover, two manpower policies have to be implemented or strengthened:

Encourage collaborations between computer and mechanical specialists by financing joint projects: 5 MF x 5 years.

Improve the research-industry technologic transfer by:

Aid for the creation of enterprises by researchers: 3 MF x 5 years;
Grants for doctoral students in industry: 30 persons (15);
Training leaves for industrialists in public laboratories: 20 persons (0);
Industrial internships for teaching personnel: 20 persons (0);
Researcher mobility (for future reference).

Machine Builders and Engineers

The major problem with information is to have high technology equipment in the shortest time and at competitive prices. Since this problem is not specific to robotics, no action is proposed.

On the other hand, a specific and serious effort must be allocated to the development of basic and applications software in robotics. In most cases this activity cannot be made profitable, but is of strategic importance. The existing support must be at least tripled, with a strong guideline policy in nationalized groups if necessary.

20 MF x 3 years (current: 5 MF/year)

Two other actions were considered important:

Define and build a family of modules for robotics, that could lead to the creation of European, and then international standards: 10 MF.

Define and build integrated circuits specifically for robotics (computer processors, servosystems, signal processing, and so on): 5 MF.

Users

The users' problem with computers in robotics is mainly psychological: the complexity of robots must be demystified by stressing their simple utilization (provided by computers).

The following actions are suggested nevertheless:

Implement "robotic hubs" preferably associated with research centers, so that potential users could train themselves and test equipment and software on neutral territory: 30 persons.

Implement preconsultation actions in enterprises (by personnel from robotics hubs or by approved independent workers): 20 persons.

Moreover, in order to coordinate the dissemination of computerized robotics equipment, it is recommended to:

Define programming standards for the principal types of robots and for communication procedures with the environment;

Define performance measurements and require manufacturers to state the performance of their equipment (with official verification);

Create an observation post for user needs, which could usefully advise manufacturers.

4) Summary of Proposed Actions

Research

Computer equipment	30 MF
Additional manpower	95 researchers
Computer-mechanical projects	25 MF over 5 years
Transfer of technology	
Creation of enterprises	3 MF/year
Doctoral candidates in industry	30 people
Training of industrialists in research	20 people
Retraining of teaching personnel in industry	20 people

Engineers and Builders

Software development	60 MF over 3 years
Family of specific equipment modules	10 MF
Specific integrated circuits	5 MF

Users

Robotic hubs	30 people
Preconsultations	20 people

Details on French Robotics Research

Paris MISSION ROBOTIQUE 2 in French Third Quarter 1984 pp 115-143

[Text] II.1 ARA Program: Computer Technology in Robotics

II.1.1 Introduction

This report attempts to define the computer requirements of robotics research, both for software and hardware. The study analyzed the development of computer technology during the past ten years, as well as the trends for the upcoming period.

The computer resources of most of the laboratories that are part of the ARA program are highlighted, as well as the progress anticipated for their research activities.

II.1.2 Computer Related Aspects of Robotics Research

Most of the authors believe that a robotized system must be organized around at least four research orientations: planning, sensing, action, and communication, a minimum of each being indispensible for a system to be categorized as robotized rather than merely automated. These lines of research require different specialties and computer resources which are often contradictory. The researchers working in this fields are often no more than computer "users" and they have a certain tendency to consider the computer as a black box with reliable operation in terms both of software and hardware. It is rarer to find in a laboratory persons with a knowledge both of robotics research and computer technology itself, a technology which however is a sort of common denominator indispensible for the completion of their work. But the computers currently on the market are far from being perfect machines, either in software or hardware, and are not very well adapted to the activities mentioned above. Added to this is a recently arisen delicate problem of nomenclature: the concepts of computer, minicomputer, and microprocessor certainly have far-reaching commercial justifications, but they very often constitute an trap for the researcher who discovers, perhaps too late, that the differences between the three "families" are much more of a quantitative rather than qualitative nature, that the abilities necessary for their utilization are identical, and that for analogous configurations, their costs can conceal some surprises.

II.1.3 Computer Technology for Research in Planning

In terms of computers, the formulation of project plans is the most unusual aspect of robotics. Programming languages considered as conventional in information processing are not well suited for this discipline, with separation of data and decision-making being two of the major problems to be solved. Considerable effort has been devoted for about ten years to the computer processing of lists. Researchers almost unanimously consider LISP as the basic language for this type of activity; several plan formulation

languages currently exist, almost all of them written in LISP. But LISP places very special demands on the host computer, and it became rapidly clear that existing computers were not adaptable to the operation of this interpreter. That is probably the major reason that has led researchers in several countries to implement LISP machines, for which it is the basic language (the computer's "assembler"). The equipment constraints for research in plan formulation, can be summarized as follows:

"Stack" structure computer ("push" and "pop" must be basic instructions);

Large capacity central memory (several megabytes of resident memory), ultimately without conventional "word" structures;

Very large capacity mass memory with high random access performance (all sequential searches lead to prohibitive execution times);

Machines structured for multi-task, synchronous and asynchronous operation;

Less than one second total response time for high level interactions;

Possible system access for several users in apparent simultaneity.

II.1.4 Computer Technology for Sensing Research

In this activity, aimed at the utilization of all sorts of sensors, "cameras" have had a privileged position for a long time. The major reason is probably because a camera is a tool capable of transforming a universe which is difficult to master and even to describe ("what we see"), into a sequence of electrical impulses, a field which is well known and that we are accustomed to handle both in computer and in purely electronic terms. From the robotics standpoint, sensing is a critical link whose results have a decisive influence on the proper progress of an experiment and on the speed with which it is performed.

A rapid summary of the major projects in sensing, shows that researchers are working on images ranging from 256x256 elements digitalized over four bits, to 512x512 images with eight-bit elements. In computer processing, the image analysis sequence consists of the following stages: scan an image, store it in a memory, process it, ultimately file it in a dictionary, and maybe recognize some of the objects represented. In robotics, it is felt that image processing could be considered as "real-time" if the complete process takes less than one second. But in a computer, all the above sequences imply a number of elementary operations ranging from 10 million (256x256x4 image with single pass analysis), to 500 million for 512x512x8 images with double iteration analysis.

In terms of computer requirements, these characteristics are reflected in the following properties:

High capacity, contiguous main memory capable of allocating several megabytes to a single task;

Absence of any pagination or similar system (virtual memories, scrapping, and so on), which are very costly in terms of waiting times;

Very high capacity disc memory (more than 500 megabytes) with high performance sequential access;

Possibility of locking, on demand, the central processor on a single task so as to concentrate all the computer's power on the analysis of a single image for a duration of less than one second;

Very high efficiency input/output system (real transfer time, including software, less than 200 ms per byte);

High floating number performance (calculations of gradients, convolutions, filtering, and so on);

High level languages that generate a very optimized code (ratios greater than 100 have been observed between two FORTRAN compilers on the same computer);

Multi-station and flexible computer utilization (access to management modules in real time from programs written in high level languages).

II.1.5 Computer Technology for Motion Research

In robotics, the word "motion" can be considered to designate all the processes that occur between the time at which a computer device sends an instruction--often digitalized--to a peripheral unit, and the time at which the mechanical device being addressed performs the requested motion. The process being carried out takes into consideration the constraints of the total mechanical system (instruction) until the tool to be activated is placed in operation. The latter can be electrical or hydraulic, and the robot is most often used to designate it.

Unlike what happens in planning and sensing, motion computer technology must be very easy to handle in terms of electronics, and failing this, must be able to support a reconfiguration or adaptation of the system to the mechanical device being used. However, we must not overlook the "instruction" aspect of this research, which often requires a certain computation power demanded by the mathematical description of mechanical processes (matrix manipulation). The real-time time aspects are different in nature from those indicated for sensing: we are interested here in actually "following" each requested action by monitoring the correct performance of each stage and if necessary, by correcting the instructions being sent. It is desirable in this respect, to constantly synchronize the changes in the real universe with those of its computerized representation, which to our knowledge has not been satisfactorily been done so far.

The computer equipment used to support this research must meet the following specifications:

Operate in real time, both for response delays to intervention requests, and for process monitoring;

Computer modules that require little memory space but which must be resident, since access times to mass memories are too long;

Equipment architecture must be readily mastered so that the system may be configured as a function of need;

Modules must be available for easy program emulation, in order to assist the design of fixed devices adapted to the mechanics of the system under study in each case.

II.1.6 Computer Technology for Communications Research

Chronologically, communications research is probably the last to have become part of robotics. And yet, the operator-robotized system dialog becomes increasingly important as the state of the art in robotics progresses and as robotized systems reach very complex levels. Knowledge of the system's state of knowledge, as well as its modification, are phases which can no longer be ignored in robotics research. The computer support necessary for communications work must include the double feature of real-time interaction, and representation of knowledge. Its fundamental characteristics are:

Sufficient central memory and mass memory for interfacing the system's data bases. Virtual memory utilization is acceptable;

High level languages which accept real-time interactions (dialog among tasks and with peripheral units);

Emulation of real-time modules which must assist in the design and implementation of specialized computer processors.

II.1.7 Evolution of Computer Technology

At the beginning of the 1970's, the major manufacturers began to mass produce the first high power computers whose major application has proven to be the endowment of computer centers. Very rapidly, the machine time for a program has become only the administrative measure of its cost, saturation being expressed by the fact that after a few minutes of required time, results are available only after a several hours of waiting time, and even the next day.

Several years later, we saw machines which were realy only environment simplifications of top of the line computers. They were much less restrictive in utilization, had a very reasonable cost, and required very little maintenance: the minicomputer was born. A research laboratory specializing in information processing, could ammortize the purchase of a minicomputer in two to three years, merely by considering the expenses saved in a computer center.

Along with this, the amazing progress of integrated electronics, as well as an intensive utilization of information processing in the socio-economic sector, encouraged the commercial adoption, as autonomous units, of what we can consider as the smallest computer configuration capable of accepting a program, the microprocessor.

At this point, the supporters of any one of these configurations began to discover similarities and differences between each of the three families, a phenomenon undoubtedly amplified by the specialization of manufacturers in each type of machine. The research laboratories have not escaped the debate which is continuing today.

Toward the end of the 1970's however, higher production costs raised new problems which are still growing at this time: the cost of software for the operation of a computer increases constantly, while that of the equipment has been decreasing for a few years.

Moreover, the relatively high cost of any computer installation, as well as the presumed operation of the machines existing in each laboratory, coupled with a real lack of specifications about the performance of the machines available for research tasks, have led to stagnation, and even backsliding, in several research laboratories, notably in robotics. Present computer resources are thus very often the same as in 1975, at abnormally high maintenance costs, while certain laboratories were able to rapidly adapt to equipment changes, obtaining installations that are less expensive to operate and definitely more efficient.

If we compare the change in the computer resources of laboratories in the ARA program, with their counterparts on the other side of the Atlantic, we note that except for the central experimental support, the respective situations were comparable around 1975, but are diverging more and more at present.

II.1.8 Robotics Research Computer

Is there a computer capable of meeting the specifications represented by robotics? Certainly not, but we can conceive of a structure which would tend to optimize the cost of an installation, its handling, and its versatility. Robotics research laboratories are probably among the first to have dropped their attachment to computer centers. The present trend appears to be the utilization of so-called laboratory computers, which can be sufficiently powerful for most applications. If needed, they can be connected through time shared lines to computer centers for more demanding requirements. They also must be equipped with fast input/output modules for plugging into specialized processor front ends.

With relatively easy programming, most of the minicomputers available today can perform the functions which robotics is likely to require from top of the line computers, under two conditions: that their hardware configuration be reliable, and that they be well oriented toward the development of information

processing supports which researchers will have to produce in any case. For the purposes of robotics in fact, the computer must be considered as a "raw material" whose adaptation to one task or another will be determined only by its programming.

II.1.9 Computer Technology Growth Necessary for ARA Program Laboratories

1) Central support
   The computer technology configuration must be completed so that it may support collective utilization.
   Approximate budget: 1200-2500 kF.

2) CERFIA (Enterprise Cybernetics, Shape Recognition, Artificial Intelligence) (Toulouse)
   Research direction: sensing, expert systems
   Available equipment: SOLAR
   Equipment wanted: complete the SOLAR
   Approximate budget: 500 kF.

3) IMAG (Grenoble)
   Research direction: robotics languages, planning
   Available equipment: LSI 11, Z 80
   Equipment wanted: complete the SOLAR
   Approximate budget: 1000 kF.

4) IRISA (Research Institute for Computer Technology and Random Systems) (Rennes)
   Research direction: sensor, CAD
   Available equipment: LSI 11
   Equipment wanted: 50% of VAX 11/750 (+50% IRISA)
   Approximate budget: 500 kF.

5) LAB (Besancon Automation Laboratory) (Besancon)
   Research direction: vision, CAD
   Available equipment: shared MINI 6
   Equipment wanted: VAX 11/750
   Approximate budget: 1000 kF.
   (to share between Besancon and Belfort)

6) LAM (Montpellier Automation Laboratory) (Montpellier)
   Research direction: two-arm manipulation
   Available equipment: T 16 000
   Equipment wanted: Concept 32/27
   Approximate budget: 1000 kF.

7) LASS (Toulouse)
   Research direction: advanced manipulation, planning
   Available equipment: part of the ARA central support machine and link to CNUSC
   Equipment wanted: LISP machine (Machine)
   Approximate budget: 800 kF.

8) LIMSI (Computer Technology Laboratory for Mechanics and Engineering Sciences) (Orsay)
Research direction: robotics information processing, sensing
Available equipment: IBM 7 connected to CIRCE
Equipment wanted: Concept 32/27
Approximate budget: 1000 kF.

9) UTC (Compiegne Technical University) (Compiegne)
Research direction: sensing, expert systems
Available equipment: network, LSI 11 processor connected to the university's computer
Equipment wanted: USP machine (Machine)
Approximate budget: 800 kF.

The total budget, of the order of 8000 kF, corresponds to an exchange rate of 5.40 F per dollar. The computer configurations studied are systems considered as basic, which should accomodate robotics activities in these laboratories for a period of about two years. An increase of 30-50 percent for the next two years could assure the competitiveness of information processing supports for 5-6 years. In no case can the equipment mentioned here be considered as computers which meet the needs of a small laboratory computer center. The research groups mentioned in this report currently find themselves in a difficult information processing situation. The actual results of their research could be seriously compromised by the difficulty of comparing them with national and international findings. The level achieved will probably be maintained only by successful upgrading of the computer systems that form the basis of robotics research.

Paris Ile de France (50 people)

General Information Processing Department +
Universite Paris 7
2, Place Jussieu
75221 PARIS CEDEX 05, Tel 336.25.25 Ext 4519

Mr Kessis
Topic: Mobile robot

Laboratory for Theoretical and Programming Computer Science +
(LITP) LA 248
Universite Paris 7 - UER de Mathematiques
2, Place Jussieu
75221 PARIS CEDEX 05, Tel 336.25.25 Ext 5370

Mr Sakarovitch
Topic: Decision structures to identify partially observed objects (RG)

Laboratory for Industrial Mechanics +
School Center for Arts and Manufactured Products
Grand Voie des Vignes
92290 Chatenay-Malabry, Tel 661.33.10

Mr Herve
Topic: Motion transmission mechanisms (Koenigs joint, wrist gear) (MT)

Technical Service for Protection and Dosimetry Equipment   +
Atomic Energy Commission (CEA)
91190 Gif sur Yvette, Tel (6) 908.60.00 Ext 6073, 2613

Mr Vertut
Topics: Transmission mechanisms: fracture, delay of effort feedback
Scale factors in a master-slave pair (MT 81 TA)

Midi Pyrenees (65 people)

Toulouse Space Center (CNES--National Space Studies Center)   +
16, avenue Edouard Belin
31055 Toulouse CEDEX

Mr Jamin Changeart   Tel (61) 53.11.12
Topic: Robotized system in space (TA)

Laboratory for Automation and Systems Analysis   +++++++
LAAS LP 8001
7, avenue du Colonel Roche
31400 Toulouse, Tel (61) 25.21.47

Mr Clot
Topic: Sensors (tactile, and so on)

Messrs Roubellat and Courvoisier
Topic: Distributed computer structure, automated shop management: scheduling and launching functions (AF)

Mr Giralt
Topics: Mobile robot
Assembly robotics: 1) Identification, location, automatic inspection
2) Multisensor perception systems
3) Contact relationships
4) Dynamic control, and so on (RG)

Toulouse Center for Studies and Research (CERT) DERA   ++
BP 4025
2, avenue Edouard Belin
31055 Toulouse CEDEX, Tel (61) 25.21.88

Mr Delmas
Topic: Design and simulation of flexible shop structures (AF)

Mr Llibre
Topic: Control of manipulator robots (RG)

Enterprise Cybernetics, Shape Recognition, Artificial Intelligence (CERFIA) ++
IUT (University Institute for Technology) Information Department (ERA 657)
Universite Paul Sabatier
118, route de Narbonne
31400 Toulouse

Mr Castan Tel (61) 53.11.20
Topics: Image processing in automatic inspection
Image analysis (RG)

Language and Information Processing Systems Laboratory LA 347 ++
Universite Paul Sabatier
118, route de Narbonne
31400 Toulouse, Tel (61) 53.11.20 Ext 351

Messrs Farreny and Beaufils
Topics: Generation and control of plans of action (RG)
LISP machine

Television and Image Signal processing Group (GTTSI) +
Laboratory for Signal Processing and Telecommunications at ENSEEIMT
2, rue Camichel
31000 Toulouse

Mr Bajon
Topics: Robotics cameras
Image preprocessing (RG)

GRECO 22
ENSEEIHT (Toulouse National Higher Education School for Electromechanics, Electronics, Computer Technology, and Hydraulics)
2, rue Camichel
31071 Toulouse CEDEX

Mr Tranoy Tel (61) 62.10.10
Topic: High performance electrical machines

Rhone Alpes (40 people)

Laboratory for Surface Technology ERA 666 +
Lyon Central School
36, route de Dardilly
69130 Ecully, Tel (78) 33.27.00

Mr Dimnet
Topic: Tribology (MT)

Laboratory for Industrial Automation ++
Mechanical Engineering Department at the Lyon INSA (National Institute for Applied Sciences)
Bldg 303
20, avenue Albert Einstein
69621 Villeurbanne CEDEX, Tel (7) 893.81.12 Ext 3587

Messrs Jutard and Liegeois
Topics: Analysis of representative industrial tasks
Electrohydraulic servosystems (MT)

Grenoble Institute for Applied Mathematics (IMAG) LA 7 +++
BP 53
38041 Grenoble

Mr Latombe
Topics: Automatic design of machining tasks (AF)
Vision system for assembly robotics (RG)
x High level languages for manipulator robot programming (RG)

Grenoble Automation Laboratory (LAG) LA 228 ++
Grenoble ENS (National Higher Education School) for Electrical Engineers
BP 46
38402 Saint Martin-d'Heres

Messrs Deschizeaux, Landau, and Nougaret Tel (76) 44.82.45
Topics: Coupling, commercial vision
Location, measurement, and inspection of industrial objects (with CCD and Vidicon Cameras) (RG)
Adaptive control: application to robots

Laboratory for Electronics and Computer Technology (LETI) +
GEA CENG (Grenoble Nuclear Studies Group)
Sorting Center 85 X
38041 Grenoble CEDEX

Messrs Monge and Sonrel Tel (76) 97.41.11
Topics: Image and signal processing electronics
x 3D Vision sensors (lasers) (RG)

Aquitaine (4 people)

GRAI +
University of Bordeaux 1
351, cours de la Liberation
33405 Talence

Mr Doumeingts Tel (56) 80.84.50
Topic: Automated production management: hierarchic coordination and synchronization (AF)

Bordeaux ENS for Electronics and Radioelectricity (ENSERB)
351, cours de la Liberation
33405 Talence, Tel (56) 80.69.25

Messrs Maison and Baylou
Topic: Agricultural robots (asparagus, grapevines, and so on)

Bretagne (15 people)

Research Institute for Computers and Random Systems (IRISA) (ERA 227) ++
Beaulieu Campus
35042 Rennes CEDEX, Tel (99) 36.20.00 Ext 2324

Messrs Espiau and Benveniste
Topics: x Prehensile devices using proximity sensors (infrared and optical fibers) (TA)
Adaptive control for flexible robots
Image processing (including medical)

Rennes INSA (National Institute for Applied Sciences) Automation Laboratory +
20, avenue des Buttes de Coesmes
35043 Rennes

Mr Place Tel (99) 36.48.30
Topic: Mobile robot

Higher Education School for Electricity, Rennes Antenne +
BP 20
35510 Cesson Sevigne

Mr Quenuc'hdu Tel (99) 20.11.00
Topic: Gripper with optical sensors: application for object grasping

Nantes Automation Laboratory (LAN) ERA 134 +
National Higher Education School for Mechanical Engineering
1, rue de la Noe
44072 Nantes CEDEX

Mr Laurgeau Tel (40) 74.79.76
Topic: Stereovision (RG)

Centre (5 people)

Laboratory for Electronics and Magnetic Resonance (LERM) ERA 90 +
University of Clermond-Ferrand II
24, avenue de Landrais BP 45
63170 Aubieres

Messrs Ackerman and Richetin Tel (73) 26.41.10 Ext 3097
Topics: Multiprocessor systems for robot control
         Shape recognition diagnostic
         Models for system behavior by automatic devices

Franche Comte (38 people)

Besancon Laboratory for Applied Mechanics (LA 4)   +
School of Sciences and Technologies
Route de Gray
25030 Besancon

Mr Chaleat
Topic: Spatial articulated mechanisms: morphologic control relationship (MT)

Besancon Automation Laboratory   +++
Microsystems and Robotics (ERA 906)
National Higher Education School for Mechanical Engineering and Microtechnology
La Bouloie, Route de Gray
25030 Besancon

Messrs Lhote, Andre, and Stepourjine   Tel (81) 50.36.55
Topics: Mechanical architecture of hydraulic robots
         Motricity modules
         Electrohydraulic components for light robotics (MT)
         Assembly task CAD
         Voice communication, ultrasound images
         Robot programming and control: application to teletheses and polishing robots

Optics Laboratory, School of Sciences and Technologies   +
Route de Gray
25030 Besancon

Messrs Vienot and Bullabois
Topics: Laser metrology and image processing
         Automation of nondestructive appearance and dimension centrals

Laboratory for Electronic Chronometry and Piezoelectricity   +
National Higher Education School for Mechanical Engineering and Microtechnology
La Bouloie
Route de Gray
25030 Besancon

Mr Besson
Topic: New sensors

Laboratory for Oscillator Physics and Metrology +
(LPMO) and CNRS
32, avenue de l'Observatoire
25000 Besancon, Tel (81) 50.39.67

Messrs Gagnepain and Olivier
Topic: New dynamic sensors

School for Sciences and Technologies +
Route de Gray
25000 Besancon

Mr Trhel
Topic: Operational research applied to shop management

Belfort IUT (University Institute for Technology)
Rue Angel Gros
90000 Belfort, Tel (84) 21.01.00
Artificial Intelligence Laboratory +

Mr Stamon
Topic: Image processing and shape recognition with application to robot vision and automatic inspection

Electromechanical Laboratory
Mr Kaufmann
Topic: Electronic actuators

Languedoc Roussillon (15 people)

Montpellier Automation Laboratory +++
(LAM) ERA 655 USTL
Place Eugene Bataillon
34060 Montpellier CEDEX

Messrs Liegeois and Coiffet Tel (67) 63.91.44
Topics: Control electronics: universal coordinate transformation (TA)
Robot CAD (RG)
Dynamic Control

INSERM (National Health and Medical Research Institute) +
Unit 103 Biomechanics
Avenue des Moulins
34100 Montpellier

Mr Rabishong Tel (67) 63.27.48
Topics: Evaluation of manipulator force and torque performance
Application to prostheses

Lorraine (5 people)

Center for Computer Research (CRIN) at Nancy (LA 262) +
Nancy IUT
Computer Department
Scientific Campus BP 239
54506 Vandoeuvre les Nancy CEDEX

Mr Cremagne Tel (8) 328.93.93
Topic: Data base management system: application to automatic shop management

GRECO 39 Voice communication +
Center for Computer Research at Nancy
Case Officielle 140
54037 Nancy CEDEX

Mr Haton Tel (8) 328.93.93

Nord-Pas de Calais (15 people)

Lille Automation Center (ERA 997) +++
D'Asq University for Sciences and Technologies
Lille I BP 36
59640 Villeneuve d'Asq, Tel (20) 91.42.22

Messrs Malvache and Vidal
Topics: Mr Jolly: Robot control by head and eye movements (aid for the handicapped)
Joint control: dynamic distribution of tasks (TA)
Mr Soenen: Real time centralized shop management
Design of clothing lines
Mr Bourton: Image analysis
Mobile robot
Automatic assembly with multi-arm robots

North Higher Education School for Electronics +
3, rue Francois Baes
59046 Lille CEDEX

Mr Carrez Tel (20) 93.61.70 Ext 245
Topics: Sensors for measuring muscular effort
Voice support robot control: aid to the handicapped

Normandie (2 people)

Laboratory for Electronics and Automation +
University Institute of the Havre
76077 Le Havre

Messrs Foulc and Lopez Tel (35) 47.28.47
Topic: Remote operation in hostile marine environment

Poitou-Charentes (3 people)

Laboratory for the Mechanics of Solids ERA 218 +
40, avenue du Recteur Pineau
86022 Poitiers CEDEX

Mr Guinot Tel (49) 46.26.30 Ext 641
Topic: Mechanics of prehension (MT)

Provence Cote d'Azur (5 people)

Marseille Laboratory for Automation and Computers (LAIM) +
Saint-Jerome School of Sciences and Technologies
Rue H. Poincare
13397 Marseille CEDEX 4

Mr Bertrand Tel (91) 98.90.10
Topic: Operating safety of remote manipulators

II.2 Files of the Various University and CNRS Laboratories Working in Robotics

Comments: meaning of some abbreviations

LP: in-house laboratory (of CNRS)
LA: associated laboratory (CNRS-University)
ERA: associated research team (CNRS-University)
GRECO: coordinated research group (CNRS training)
AF: flexible shop (ARA group hub)
RG: general robotics (ARA group hub)
MT: mechanics and technology (ARA group hub)
TA: advanced remote operation (ARA group hub)

The persons indicated in the files are the people to be contacted: they are not necessarily the managers either of the laboratory or the laboratory's robotics operations.

The asterisks in front of some topics (or robotics operations) reflect either the importance of the topic in the laboratory's scientific policy, or its originality at the national level. These are therefore research strong points.

For the sake of completeness, we should mention an ongoing joint action between MRT and CNRS, on sensors, supervisec by Mr Desjardins.

Estimate of the number of researchers or teaching personnel performing research, working primarily in robotics, as follows:

+ up to five researchers
++ six to 10 researchers
+++ 11 to 15 researchers
and so on in increments of five.

LAAS for instance, has 35 researchers (+++++++).

II.3 Orientations, Developments, and Structuring

II.3.1 Orientations

The present situation in scientific research and the development of society places the SPI (Information Processing Company) Sector of CNRS in a privileged role for achieving a double objective: increase the level of knowledge and improve know-how.

Section 02, "Information Processing, Automation, Systems Analysis, Signal Processing," covers a large number of the topics which best characterize this dual scientific and socioeconomic importance.

During its 1981 Spring Meeting, Section 02 had already adopted a unanimous position on this dual aspect, as well as on the importance of the role that must CNRS muat play (appendix 1) which we believe to be an essential one.

The sector's guidelines, formulated in September 1981, analyze and define the major directions of a desirable and possible policy. A recent statement of the Section 02 task force director, dated 12 March 1982, summarizes and updates the present general organization of the section's activity (appendix 2).

Following these considerations, the memorandum stresses various points considered as characteristic and very important for the development of research in computers and automation, and for the growth of Section 02 starting from the current situation.

A very young section, created at the formation of SPI in 1975, it can be characterized by several figures:

It consists of 40 research groups which range from in-house laboratories (LP) to joint program research groups (RCP);

These groups comprise (February 1982) 240 engineers, technicians, and administrators, 156 researchers, and about 950 (equivalent full-time) various researchers (particularly research professors);

The averaged basic support in 1982 consisted of 12.4 kF per equivalent full-time researcher. Added to this were 6600 kF in research allocations under ATP-ASP or specific program (ARA and so on) entitlements, and 2100 kF for heavy equipment.

The contribution from the SPI sector of the National Committee at the National Colloquium on Research and Technology noted that:

"Although the total existing resources, both human and material, are not at all negligible, they are far from meeting our responsibilities and hopes for the progress of knowledge and the satisfaction of cultural needs, as well as for facing the national needs in technical and socioeconomic areas."

It concluded with the affirmation of a "need to proceed to double the resources of the sector over a period of four to five years."

For Section 02 this appears as an absolute necessity, partly because (does it need to be repeated?) it corresponds to the developing needs of computer technology both nationally and internationally, and partly because it it strictly necessary for the very balance of French research, of the role that CNRS must play, and of the coherence of this role in terms of its present objectives and tasks.

With respect to some of the disciplines covered by this section, the conjunction of two factors will never be sufficiently emphasized: economic and social importance on one hand, and to be stressed once more, the importance of knowledge on the other hand.

In this light and consistent with the provisions of the guidelines for a larger number of ITA, researchers, and material resources, particular attention must immediately be given during the 1982-1983-1984 period, to:

Endowment with research computer equipment. A study underway should make it possible to not only evaluate reasonable needs as completely as possible, but also to define a policy for satisfying these needs (32-bit computers, "importation of large software programs," and so on);

Come as close as possible during this period, to a doubling of ITA personnel. Take into consideration the incredible penury of some groups (clerical, engineering, and so on);

Increase the research staff by 50 percent. This should be obtained partly through a large influx of new positions, and partly by an internal flow of very good CNRS researchers toward the SPI sector and Section 02;

Triple the influx of grant supported students (BDI, third cycle). The importance of training for and by research in some topics of computers and automation, is such that the number of scolarship students with proper status should have been tripled as of this year. Each year of delay will be heavy with consequences, particularly for the applications sectors (witness the current demand for highly qualified personnel in robotics);

Real possibilities (the means!) for intermediate and long term exchanges (1-4 years) among other organizations, industry, and CNRS, in both directions and at all levels, from applications technicians to research engineers.

This effort for internal consolidation and development can and must be accompanied by an expansion through integration of scattered researchers and small isolated groups, and through a larger number of associated groups.

These are broad actions in a CNRS policy for basic research and finalized research, and for mobilizing programs in science and technology that would make it possible to create a framework and determine the lines of strength of this development.

CNRS is particularly well positioned to carry out in association with other organizations, vast programs capable of providing--through long term objectives and in conjunction with application considerations--the scientific perspectives, mobilization, and impetus which would allow us to fight with equal weapons against countries whose economic resources are much greater than ours.

The following large programs in accordance with the section's guidelines, appear particularly likely to strongly structure the section's actions during the period under consideration (in order of increasing novelty):

Carry out and develop the Automation and Advanced Robotics (ARA) program, which could also play an important role as part of a general action in robotics. The ARA program associates nine organizations with CNRS and gathers together about 150 researchers in 29 teams. Future expansions of objectives and resources should follow the conclusions of the Robotics Task Force;

Carry out GRECO's, Parole, Programmation, and Formal Computation programs. A synergy between the two latter actions is to be sought;

Develop the current Control of Complex Technical Systems (ATP) action, and transform the action by installing a GRECO for Control of Complex Systems (transportation, telecommunications, and so on);

Install a large multi-organization program devoted to one of the key problems of present computer technology, distributed computers and parallelism. It represents the creation of C3, "Cooperation, Communication, Competition." This program should take a central position to structure and energize French computer research. It should be larger (financial resources, researchers at work, involvement of other organizations than CNRS, industry) than the ARA program in its present form. A first project will probably be presented at the end of May following the spring meeting of the National Committee.

A specific Artificial Intelligence Action (natural language, expert systems, representation of knowledge, and so on) is certainly timely in France. And whether we believe in it or not, we must also take into consideration the fifth generation Japanese computer program.

Here, CNRS is once more in a good position to organize and manage this action, due to among other things, the investment already made in this field (existence of an Artificial Intelligence ATP since 1979). Such an action could be installed (scientific program, participants, responsibilities, and so on) and could start in 1983.

These programs aim to form a framework and lines of force for the general orientation of research. They of course link Section 02 to the other sections of the SPI sector, as well as to sections belonging to other sectors such as mathematics, human sciences, social sciences, and so on.

They do not intend to reduce the interest and importance of other topics which very normally and very happily are part of the research field of the section.

II.3.2 Developments and Structuring

Robotics research in France is carried out by various organizations:

Large public research organizations: CNRS, INRIA (National Institute for Computer and Automation Research), ONERA-CERT (National Office for Aerospace Studies and Research-Toulouse Center for Studies and Research), CEA, CNES;

Industrial laboratories;

Technology centers or merged organizations: ADEPA (National Agency for the Development of Automated Production), CETIM (Technology Center for Mechanical Industries).

Although it must indeed be increased if we are to face the technologic and socioeconomic situation of the 1980's, the research effort underway is already at an interesting level and is in no small portion the beneficiary of a cooperation activity. The ARA program, for instance, led by CNRS, merges ten large organizations, brings together about 30 groups, and represents the activity of more than 150 researchers (full-time equivalent) (see appendix I).

The support and development of this research effort requires first of all the maintenance and growth of resources that research and research-development organizations can devote to their robotics programs.

This also requires that specific resources be allocated to:

Support the research and research-development actions of industrial laboratories, and encourage collaboration with other partners, such as public laboratories, through convergent actions, pilot projects, and so on;

Encourage the formation, and support the proper pursuit of intermediate and long term multi-annual research programs coordinated at the national level.

The diversity of the partners involved, requires and justifies the presence of various action and financing organizations. The establishment and maintenance of coherent research activities then becomes an essential task which could be turned over to a high-level structure, the CIR.

The ARA program with its four hubs, Advanced Remote Operation, Mechanics and Technology of Assembly Robots, General Robotics, and Flexible Shops, is a vast basic research program which encompasses many ambitious points. It is however

limited by resources, of course, but equally by the topics of interest, since the field to be covered was voluntarily restricted in 1980 when the action was started. A vast joint action appears possible today. And while some aspects of complementary research could expand the extent of the ARA program, they should remain marginal and the complementary actions in the strict sense of the term should occur outside the ARA structure.

Thus, using the ARA program as a reference, the proposals can be reformatted into three chapters: General Research Environment, Robotics Research, and Transfer of Research and Development:

1) General Research Environment

Three large research programs that cover fields of considerable scientific interest, would constitute a powerful upstream environment for robotics research on second and third generation systems.

These programs, which could be organized in a manner similar to ARA, are (in decreasing order of definition status):

The Cooperation, Competition, Communication (C3) program, which concerns distributed and parallel computers systems (see appendix II);

An Artificial Intelligence action, which could bear on the representation of knowledge, learning, and expert systems;

A Mechanisms action, which while covering a broader field than the needs of robotics, could find support and incentive in those needs.

Proposal 1

Support (facilitate implemention if necessary) for these three actions;

Assure communication with robotics actions, notably ARA, with which links and exchanges should be important.

2) Robotics Research

Proposal 2

Bolster the Automation and Advanced Robotics action:

Through reasonable growth of specific allocations in 1983 and 1984 (*);

Through rapid distribution to appropriate laboratories, of the computer means indispensible for today's research in robotics (appendix III **);

Expand, but to a limited extent, the work program as an alternative or in relation to a new external action.

Proposal 3

Implement a concerted action over four years on CAD in robotized production systems. The problems examined will be focused on the Study Bureau-Service relationship method for its integration in the optimization of products and manufacturing programs.

This action could be led by ADI, or failing that, directly by MRT (Ministry of Research and Technology). It would fit into the ARA environment as part of the General Robotics hub, and especially within the Flexible Shop hub, which it would complement very well.

Proposal 4

Implement an intermediate and long term coordinated action on "laser machining" as part of flexible production cells.

Proposal 5

Orient and support an action similar to ADI's Pilot Project, such as SIPION, concerning real time information processing and flexible shops.

This would serve as a test bench and transfer vector for the Flexible Shop hub of the ARA program, and for the C3 program.

* A 40 percent annual increase in current francs appears as a minium assumption (ARA's 1982 budget is 12 MF).

** The evaluation of needs given in this note falls within the general evaluation made at CNRS by the SPI sector.

The selection of one or two significant experimental supports in the areas of applications and of the value of methods and tools, should be carefully made. The on-site "experimental" phase should occur toward the end of 1984.

Proposal 6

Implement a concerted action on Mobile Robots, which over four or five years would be aimed at the development of automated intervention vehicles, primarily in industrial and agricultural operations.

Extensive exchange relations should be created between this new action and the ARA and Artificial Intelligence programs (if the latter is finally installed). The action could be led preferably by ADI, or constitute a CNRS GRECO.

It should be noted that two public actions on this topic are presently underway:

One, close to industrial objectives, is supported by ANVAR;

The other, with an artificial intelligence orientation, merges four teams in an action led by CNRS' ATP on Artificial Intelligence.

Proposal 7

Develop a particular research and research-development effort in the area of quality control; more specifically, define a research program which would consider dimensional control problems, or more generally, robotized metrology.

It is important here to point out that quality control can be analyzed in two parts:

One, concerning the control of appearance and completeness, also called inspection;

The other, regarding the matter of conformance to reference dimensions, in other words, a metrologic study.

The first aspect is considered by the present ARA program essentially under "visual" inspection.

The second aspect, which could involve touch sensors, could constitute an extension of the work program managed by ARA's Mechanics and Technology hub.

If an independent action should appear to be justified, it should inescapably take into consideration the activities already implemented.

Proposal 8

Organize and energetically support the sensor development activity for second and third generation robotics.

The manner in which this support will ultimately be provided, greatly depends on whether a sensors action does or does not exist at a more general level than robotics.

Sensing functions are well handled in the ARA program (vision by the General Robotics hub, and means of sensing by the Mechanics and Technology hub).

Two possibilities thus exist at this juncture:

Expand ARA's activity in this field;

Form a specific sensor activity with a robotics application carried out in close relation with ARA.

Proposal 9

Define and install in the the economy in the very near future, and within a four-year time frame, an action covering working, ergonomics, and advanced automation systems conditions in manufacturing.

This action could be of the national observatory type, and be associated in order of preference, with CESTA or ADI. It could also be established in the GRECO mode within CNRS.

Proposal 10

Support an electromechanical action aimed at electric motors and their control electronics, for their utilization in robotics.

This action could be be carried out satisfactorily through the High Performance Electric Machinery GRECO, which combines seven teams under the scientific leadership of Professor Trannoy.

The preceding proposals essentially concerned equipment and operating resources. However, the personnel aspect plays a vital role whose satisfaction is a priority.

All the public teams currently amount to somewhat less than two-thirds of the researchers working in robotics.

A realistic and priority objective is to double this personnel in the next three or four years.

At the same time, the need for high level specialists to further increase the ratio of personnel in industrial laboratories or specialists working in industrial situations, also places priority on a stream of graduating researchers, that is, specialists trained in research.

Proposal 11

Create a sufficient number of budgeted positions for researchers and ITA's in the public research organizations involved (see appendix IV).

Proposal 12

Immediately create, starting this year, a sufficient number of training grants for robotics research (see appendix IV), so as to aid the objective of increasing the number of specialists in the near future.

As we have seen, about 30 research teams are working at a good level of competence in robotics.

About 30 grant students per year in 1982, 1983, and 1984, added to the already existing scolarhips, would constitute an effective and reasonable measure. For this year, given the already late date, a minimal "salvaging" measure would be to award 20 scolarhips which could be assigned for two or three years (exceptionally) to young engineers (BDI), or to provide retraining scolarhips for young mathematicians, physicists, or even specialists in non-scientific disciplines. This number (20) could be absorbed without any difficulty by ARA teams. Presently existing ARA grants represent an annual contribution of five to six people.

This proposal is not aimed at helping laboratories. It constitutes an emergency measure to preserve the development of advanced automation in France.

The next proposal falls within the same concept.

Proposal 13

Facilitate research-industry exchanges by creating a fund for permanent training, which would make it possible to support long term laboratory internships for industry's engineers and technicians.

This completes the proposals which currently make researchers and technicians from public organizations available to industry.

3) Transfer Centers

Various projects exist, aimed at creating in a research environment (ARA and so on), and sometimes in relation with technology centers, other centers, organizations, companies, whose common characteristic would be research-development and production objectives, as well as the creation of "innovation."

This is not the forum for examining all of them. In their diversity, they present a range of possibilities which should be exploited reasonably but rapidly.

Proposal 14

Facilitate the installation, and support organizations for the development of innovation resulting from on-going research, which consists of strong and efficient bonds with the sector responsible for creating and promoting new technologies in manufacturing.

Proposal 15

Launch very rapidly, as soon as possible, two demonstration actions for robotization technology in two different sectors of manufacturing, by merging in the field an effective multidisciplinary team composed of the "robotizer," the company providing the application, representatives of the company's personnel and unions, an economist, a sociologist, and an ergonomic specialist.

Conclusions of Commission's Report

Paris MISSION ROBOTIQUE 2 in French Third Quarter 1984 pp 209-226

[Text] IV.1 Impact of the Robotics Sector

The aim of the dynamic program proposed by the commission is to provide France with a robotics sector that is competitive and effective on domestic and foreign markets, by making this sector independent of the major industrialized countries at all stages of the "design-production-distribution-utilization" chain.

The robotics sector is a rapidly growing, direct and indirect economic activity, whose effect on all user sectors is to maintain or consolidate the progress and competitiveness of French products on all markets, through greater productivity in the manufacturing industries. This international competitiveness must be guaranteed by a French robotics sector with high added-value (objective of more than 60 percent), a sector which has thus mastered the areas of components, materials, software, as well as design, consultation, utilization, and sales services.

The revitalization of the French manufacturing industries, which represents a market of about 5 billion francs for additional equipment in 1985, must take place by a progressive transition from the present situation, namely from an inventory estimated at 850--of which 60 percent is foreign, to a future situation of 5000 genuine robots installed by 1990.

IV.2 Areas of Intervention, Priority Objectives, and Consequences

IV.2.1 Areas

Past and present analyses show that the evolution of robotics is an established fact, and that the technology of these products is in constant flux. The dissemination of robot utilization is the result of a theoretical and technologic mastery of many disciplines, such as mechanics, hydraulics, electronics, electrical engineering, and the recent developments in optics (control, laser processing, optical fiber transmission).

The formulation and implementation of a French robotics plan is aimed at making the products competitive on international markets. This imperative requires first of all that we become equipped with structured and organized resources adapted to the economic stakes and to the critical size of the major competitors. All of these resources will be capable of "polarizing" along the long term proposals of the commission.

Priorities will be defined as a function of allocated budgets and of the short term situation, in these areas:

Research and development
Industrial
Commercial
Financial
Socioeconomic
Educational.

IV.2.2 Priority Objectives

The multidisciplinary nature of robotics requires that every French strategy be defined in concert with the strategies for electronics, computer technology, and mechanics, particularly machine-tools.

The immediate creation and establishment of an Interministerial Robotics Committee (CIR), to manage the national effort, will make it possible to coordinate efforts and, by the end of 1982, to define priorities as a function of the conclusions reached by the various studies launched by the robotics commission.

In the short term, the implementation of the French robotics strategy hinges about the existing public and private laboratories that have been surveyed, and about the manufacturers already operating in this sector.

In the intermediate term (two to five years), a plan of coherent actions on the part of all the concerned economic agents, is structurally directed and supervised by CIR.

In the long term (five to ten years), the goal is to develop an independent French robotics industry, integrated so as to:

Progressively restore its trade balance and strengthen its xportation capacity (current coverage of 60 percent). This involves the creation of nearly 2000 highly qualified jobs;

Increase the productivity of French manufacturing industries by 25-30 percent in the years to come, thanks to robotics investments. This would reduce production costs by about 10 billion francs, thus making it possible to bolster our positions or regain lost markets, and to create even more qualified jobs due to a dominant position on the market.

The demonstration of this very important point will be the object of a socioeconomic study which the commission recommends should be started as soon as possible.

IV.2.3 Consequences Expected From Priority Actions

In the short and intermediate term (two to five years), priority actions based on present conditions are devoted to recapturing the domestic market and some neighboring or captive markets, by implementing all the means whose fundamental results will be:

Restructure, control, and orient supply on the basis of:

At first, large nationalized enterprises, surveyed manufacturers, and existing structures;

Later, a decentralized and regionalized robotics network adapted to the diversity of needs. Agreements for manufacturing under license, and for selling complementary products that are not available in France, could be sought from leaders in the respective areas;

Sharpen the awareness of demand, encourage and foresee it, as part of a sectorial approach which encourages the development of functional, modular, standard, and standardized systems (catalog products);

Encourage and assist the development of logistics support (initial and continued training, distribution networks for equipment and software, robotics service and consultation companies--SSCR), which assure the promotion of French products on domestic and international markets;

Orient and support the development of standard and standardized quality products (systems, equipment, components, software, service, and so on), which have a place on international markets. The development of these products is to be fitted in the framework of private and/or public initiative projects, and of university-industry multidisciplinary actions at the national and/or European level, as a function of their strategic contribution to the sector's independence.

IV.3 Commission's Proposals

The nine proposals advanced by the commission are reviewed in this chapter. They concern all the structural elements to be implemented, and are covered under the headings:

1) Creation of an Interministerial Committee for Robotics
2) Specialization hubs
3) Research and development
4) Pilot operations
5) Training
6) Information and promotion
7) Qualification of components
8) Industrial structure and organization
9) Financing

A serious financing effort must be made to support nationwide applications programs in research, technology, development, and industrialization. The overall budget necessary to support this plan is 2400 MF over three years.

A recommendation for the magnitude of the effort to be made and for a relative value in the areas of interest, is given in the table summarizing the distribution of the three-year budget by perfomers and actions. The

allocations should take into account the amounts already budgeted for organizations such as CNRS and CEA. These amounts naturally fall into a budget to consolidate existing programs. The proposed policy is materialized in the installation of 410 researchers over a three year period, to be assigned to existing laboratories, both public and private.

IV.3.1 Creation of an Interministerial Committee for Robotics

Through the number of disciplines involved, robotics falls under the jurisdiction of many ministerial departments, and many private, para-public, and public organizations, whose interventions have never been coordinated. As a result of product development and of the importance of the stakes for the national economy, robotics and its future closely depend on the national effort for research, development, and technology, all of which lie upstream of any economic sector.

The national effort for research, development, and technology must be mobilized as a function of users' needs and the laws of the market, which correspond to the actual conditions downstream. That is why the commission urges the creation of an Interministerial Commiittee for Robotics. This interministerial committee would federate all the existing organizations which operate in the area of robotics. In particular, it would expand the functions and actions undertaken by the CODIS Robotique group for the purposes of robotics and production automation. This committee, organized around a direction committee, an executive committee, and a scientific and technical council, would coordinate the implementation of the government's policy and the utilization of allocations for robotics and production automation in various interministerial departments, while monitoring their proper management consistent with the administrative regulations for public funds.

In the application of government policy, this interministerial committee would:

Focus all existing structures on priority national objectives, rather than create new organizations;

Determine the credibility of actions to be supported;

Monitor the coherence of licence and trade agreements with foreign companies;

Mobilize the allocations made to existing structures (ADI--Agency for Computer Technology, ANVAR--National Agency for the Implementation of Research, ADEPA--Association for Automated Production Development, DIMME--Directorate for the Metallurgical, Mechanical, and Electrical Industries, Procedure Meca), which would remain responsible for the management of projects under their respective assignments;

Evaluate the results obtained by the supported projects.

In the orientation of the national policy:

The interministerial committee would have its own operating funds, which it would use to finance prospective studies and trend analyses;

These funds would allow it to support ad-hoc actions that have not yet been defined.

All the financial effort coordinated by CIR should develop over a ten-year period. The major efforts should be planned for the next three years in the form of high risk and low return strategic investments.

IV.3.2 Specialization Hubs

The commission proposes the creation of specialization hubs which could transform themselves into an Institute for Production Automation once they have demonstrated their effectiveness and gathered together the necessary talent. At the regional level, the objectives of these hubs would be to:

Transfer high level research;
Assure the transfer of automation technologies;
Disseminate methods and techniques in manufacturing industries.

Without overlooking existing conditions, the commission opted to support immediately, as an example, two experimental hubs, one in Besancon and the other in Toulouse, where existing structures provide the necessary potential, distributed among the following organizations: ADEPA, engineering schools, technology centers, public and private laboratories. manufacturers, and users.

These two hubs are being studied.

The Besancon Hub will specialize in robotics engineering and perirobotics, especially in light robotics. It will be established from the start as an Automatic Production Institute, and will be assigned the certification and qualification of components.

The Toulouse Hub, named Midi-Robots, is designed to associate manufacturers and laboratories, one of its aims being the predevelopment of robotic products, with strong emphasis on computer hardware and software.

These hubs, established under CIR's direction, will involve all the economic entities that are concerned (local collectivities and EPR) and in a position to financially support national and regional programs.

Resources allocated to the hubs: Staff 25 x 2 = 50 persons
Equipment =
Various subsidies =

IV.3.3 Development Research

1) Major research programs

The commission advocates efforts concentrated on five major topics, based on existing research capabilities and structures in the following fields:

1) Advanced automation and robotics (ARA)
2) Components
3) Economic and social sciences
4) Automation of continuous processes
5) Associated disciplines

ARA Program

Primary program for robotics research. In 1982, it brought together 30 teams and about ten manufacturers. It must receive considerable support, particularly in the two areas of general robotics and of mechanics and technology. It must begin to consider the area of artificial intelligence. Financing in the form of program contracts will include a budget for researchers' grants.

Components Program

The action proposed for components take into account the state of the art. Efforts should be made in:

Internal machine sensors and environmental sensors;
Hydraulic, electric, and pneumatic motorization;
Peripherals, tooling, and kinematics;
Industrial computer technology (hardware and software).

Financing will take the form of concerted actions and industrial research assistance.

Economic and Social Science Program

This program must study the economic and social impact of automation, and its consequences on employment in particular.

A program entitled "The Economic and Social Changes of Automation" (AMES Program) is being prepared.

Launching of Action

The action to be launched will address itself specifically to continuous processes, which are still a large portion of the total automation market.

Liaison With Major Programs in Associated Disciplines

Computer technology (C3 program for computer technology)
Electronics (specific integrated circuits actions)
Mechanics (machine-tool plan)
Optics (Laser Club)

2) Development

The major portion of the effort will be aimed at industrial development.

Specific Topics

These topics must be explored in greater detail as part of development support actions launched by the Ministry of Industry, ANVAR, ADI, and so on:

Impact of robotics on quality improvement;

Methods necessary for implanting robotics in production processes, taking into consideration working conditions and man-machine problems;

Influence of robotics as catalyst in the development of new processes, such as power lasers in the mechanical industries;

Development of mobile robots specific to such sectors as agriculture and materials handling.

Ad-Hoc Actions

These ad-hoc actions are necessary for the organization of the robotics sector. The expected results are for the more or less long term:

Identification of technologic and industrial sectors compatible with various components;

Definition, development, and fabrication of products specifically for robotics (families of modules for robotics, specific integrated circuits, and so on), which could result in a European standardization at first, and in an international one later;

Search for solutions compatible with a modular integrated or hybrid technology systems approach adapted to robotics, and to a flexible shop approach;

Supply of strategic materials and components at the global level of the robotics plan;

Familiarization and training of robot designers and users, to the technologies and utilizations of robotics.

The total budget of development assistance (ANVAR action, political allocations for industrial actions) for robotics must be of the order of 1400 MF over three years.

IV.3.4 Pilot Operations

The commission proposes to implement pilot operations in the form of national projects comparable in scope to ARA and/or ICAM in terms of assigned objectives and resources. These pilot operations will be working on industrial projects in association with the most competent research structures.

The success of manufacturing automation actually requires new product designs in a systems approach. As a comparison, the electronic components industry requires the fabrication of specialized equipment whose cost represents about 50 percent of the product cost.

The commission suggests pilot projects for flexible assembly shops for the manufacturing industries. These shops would be based on standard modular elements which could be interconnected for progressive utilization. These pilot projects should make it possible to evaluate the true socioeconomic impact of robotics on the manufacturing industries, and in particular, its consequences on employment and working conditions.

Priority Actions

These are mainly concerned with families of industrial products such as:

Electric motors for automobile accessories
Electronic components (clean room work)
Electronic circuit cards
Switches
Instrumentation devices
Clutch mechanisms
Automobile optical units

Resources

Those to be used for these pilot projects have been evaluated as complements to existing ones. The industrial leaders for the pilot projects would contribute to their financing to the extent of normally acceptable industrial costs. The subsidies and financing allocated by the plan, cover only expenses for research, studies, and development.

IV.3.5 Training

The commission' training group has analyzed the initial and continuing training needs imposed by the development of robotics. For the time being, the commission does not deem it necessary to propose the creation of a school specialized in robotics. It does propose that the existing potential (robotics option) be used as part of current structures in university education, engineering schools, and research laboratories.

It remains for CIR, based on the development of the robotics industry and on the demand for specific personnel, to determine within two to three years if a system of integrated training is better adapted than a system of optional training. If it does not end up being standardized, it is important for the robotics education to be structured under the control of experts which will be accredited and approved by CIR and the Ministry for National Education.

Four levels of training are clearly defined for students, teachers, and industrialists, namely:

First level: familiarization for non-specialists (about 100 persons per year);

Second level: education for production users (500 additional persons per year). Out of 7000 people trained in mechanical and electrical BTS or DUT, only 700 are truly trained in automation. Their number would thus be increased to 1200;

Third level: training for specialists in robotics research and industry (about 100 persons per year). This number is being reached if we cumulate the specialized training under way or being planned in at least ten centers (engineering schools or universities);

Fourth level: training for professors, trainers, and industrialists in the form of continued education (concerns about 1000 persons over two years, with terms of one to three months).

The following table identifies the proposed actions:

Summary of Proposed Actions

Nature of training	Necessary Actions
a. Familiarization	
Initial training of non-specialists: Senior technicians Engineers	Creation and distribution of teaching films and of a photo library
Continued training of decision-making personnel	Same

b. Formulation of associated training programs

DUT GE (automation option)
DUT GM (production)
BTS (mechanical-automation)
DUT GM (design)
Production engineers

c. Development of specialized training

DUT automation (experimental)
Automation and robotics engineers
Long term continuous training phases
High level specialized phases
Research training
Teacher training phases
Industrial phases for engineering students employed by companies for robotics engineering consultation (SCIR)

Selection and distribution of teaching mini-robots (industrial computers course)
Same, plus orientation toward TP on an instrumented related direction
Creation and distribution of CAD-CAM microsystems
Endowment with an industrial robot (middle of the line) and with a CAD-CAM microsystem
Focusing of training in several Regional Competence Centers:
Endowed with heavy equipment (4-5 MF)
- Electrical and hydraulic industrial robots
- Numeric control machine-tools
- Image processing systems
- Powerful CFAO3D

And supported with personnel in specific jobs:
- Technicians
- Teachers

IV.3.6 Information and Promotion

The information circuits among the various private and public organizations will be built around existing structures:

AFRI, an association of manufacturers, is the primary dissemination, promotion, and information organization for robotics applications in France. Its activity will be supported and strengthened;

Scientific companies, AFCET, ISF, and SEE, must increase their assistance activities to disseminate robotics research, by coordinating their actions (conferences, workshops, international representation).

CIR will assign to these organizations specific actions necessary for a coherent robotics plan, such as:

Prepare a file on components currently available on the market;

Prepare a file of research and development efforts undertaken by the major industrialized nations and major manufacturers;

Implement a system to monitor and foresee the needs of manufacturing industries by sector of activity;

Organize and encourage the participation of manufacturers in specialized shows, as focal points for the promotion of French products;

Create a high quality, major robotics journal whose level will be acknowledged by manufacturers and professional users.

IV.3.7 Component Qualification

International competition both on the domestic and export markets imposes the need to support the launching of a robotics industry with promotional actions based on the performance and quality of products, compared to the competition. During the launching phase, these actions are of primordial importance for the organization of the French industry.

It is therefore important for the robotics industry to supply existing organizations with the means necessary to meet this requirement. The major actions are:

Implement a system to evaluate components, robots, and peripherals. This action can be carried out in concert with the principal European countries;

Establish procedures and methods to evaluate robotization needs, adapted to the major sectors of the manufacturing industries;

Develop quality assurance and generalize the concept of value analysis applied to the tool-product as a whole;

Formulate within AFNOR specific standards for robotics, first at the European and then at the international level.

IV.3.8 Industrial Structure and Organization

The commission insists on the fact that the robotics explosion, both at the supply and demand levels, will cause a structuring among middlemen, who are involved beginning with a definition of needs until the recommendation and distribution stages. A comparison can be made with the development of microcomputers and the actions undertaken by the world's major manufacturers.

The commission insists on the need to stimulate demand, and to this end advocates a greater endowment of robotics equipment to regional promotion technical structures which work with PMI's, notably in ADEPA's regionalization program. It is important that the promotion structures have a critical mass of equipment and brain power.

The objective of the industrial structure and organization actions consists of "industrializing" all the functions which arise during marketing, with priority given to French products, so as to regain the domestic market, but equally as well on the major developing markets.

The commission advocates that specific financing be planned for actions which affect all the economic agents that intervene in the robotics industry. These actions will contribute to the structural development of French robotics.

Contact and collaboration among the major hubs of the robotics industry. The results will be an improved transfer of knowledge downstream, and a realistic approach to the domestic needs for international market products.

Formulate automation plans adapted to PMI's, starting with opportunity studies as well as technical and financial feasibility studies performed by regional centers and by SSCR's specialized in robotics engineering.

Support the creation of enterprises with recognized and approved robotic competence, using researchers, engineers, and specialists gathered together in structures such as robotics service and consultation companies, companies for service and consultation in robotics engineering, or joint economic companies.

Organize recommendation-distribution networks at several levels, focused on consumption zones and encouraging the structuring of the French robotics network.

IV.3.9 Financing

Financing of Demand

Many incentive procedures have been implemented, as well as research support procedures, at ANVAR, ADI, and ADEPA (MECA procedures and so on).

It should be noted however that one of the serious problems of robotics and automation is that except in a few instances, the automation agent never earns any money. As an example, ASEA is only beginning to show a profit after having delivered more than 1500 robots.

Conversely, the automation recipient is sure to increase its capabilities and improve its productivity after correctly integrating robotics, even if installation schedules are not respected. It changes its scale and retains its industry for the future, profiting on each product unit it manufactures with the automatic installation. The cost of installation is hard to determine and estimates are not always respected, often due to the automation itself.

It is very harmful to cause financial losses for competent automation agents which can disappear after several unfavorable experiences. It can be equally serious for the automation recipient to be disappointed by a poor installation limited by an inadequate budget. It therefore appears interesting to connect both partie by having the first benefit from the latter's profits.

It is possible to imagine a "mutual pool" which receives a certain percentage of the price of products manufactured by automatic equipment under this new procedure. The starting pot would be provided by an advance from public funds. This would make it possible to finance two types of interventions:

Before completion, take into account the price spread between the amount of the estimate and the amount the automation recipient reasonably expects to be able to pay, given his available financing resources;

After completion, total or partial compensation of the difference between the cost price for adapting the catalogued items, and the estimated price. In this case, the automating agent should provide all technical and financial justifications to experts of the mutual organization, who would decide rapidly and without appeal as a function of the conditions of the operation.

This original procedure would in fact be a perfectly valid extension of the principles implemented by ADI with the DAP formula, and by ADEPA with the MECA procedure. It is interesting to emphasize that this formula would make both parties fully interdependent, giving the the automation agent an incentive to properly complete the equipment installation so as to derive maximum profit.

Reduced Duration of Fiscal Amortization

To encourage the industries to obtain automated production equipment which requires a considerable investment, special measures should be considered, such as:

For a limited period (end of 1987), the duration of fiscal amortization for equipment could be reduced to two years, thus allowing enterprises to increase their self-financing during the launching and installation phase.

Extension of Low Interest Loans

The distribution of low interest loans by the government should not be limited to some organizations, but should be allowed for all financial organizations, and particularly for those working with PME.

Financing of Incorporation Investments

Studies of opportunity, and of technical and financial feasibility, necessary for proper installation of robotics equipment in existing industrial structures, should benefit from subsidies (ANVAR and ADEPA types) as incorporation investments. The amount of the subsidies would be doubled when the corporate investments are materialized in 6-9 months.

IV.4 Summary of Additional Efforts Requested by the Robotics Commission

(A) Propositions d'actions gérées par le CIR	(B) Effectifs supplémentaires	Budget en Francs 82 (MF) (C)									Total
		Equipements (D)			Contrat programme, Action concertée, Aide au développement... (E)			Subventions diverses (F)			
		83	84	85	83	84	85	83	84	85	
Pôles de compétences (G)	50	15	15	15	-	-	-	15	20	10	90
Recherche (H)	300	35	35	-	100	100	100	-	-	-	370
Développement (I)	-	-	-	-	450	600	350	-	-	-	1400
Opérations pilotes (J)	60	10	10	10	70	70	70	-	-	-	240
Formation (K)	-	15	15	-	-	-	-	10	10	10	60
Information et Promotion (L)	-	-	-	-	-	-	-	20	20	20	60
Qualification des constituants (M)	-	-	-	-	-	-	-	20	20	20	60
Structure et Organisation industrielle (N)	-	10	10	10	25	25	25	5	5	5	120
	410	85	85	35	645	795	545	70	75	65	2400
Total		205			1985			210			

Key on following page

Key: (A) Proposed actions managed by CIR
(B) Additional personnel
(C) Budget in 1982 francs MF
(D) Equipment
(E) Program contract Concerted action Development aid
(F) Various subsidies
(G) Competence hubs
(H) Research
(I) Development
(J) Pilot operations
(K) Training
(L) Information and promotion
(M) Component qualification
(N) Industrial structure and organization

IV.5 Distribution of Three-year Budget by Actors and Actions

Domaines d'actions (A) / Type d'établissement (E)	(B) Machine Robot Périrobotique	(C) Constituant Capteurs Actionneurs	(D) Engineerie ACTION PILOTE Logiciel Etude Produit Liaison CAO, etc.
Grands organismes de Recherche 300 (F)	100	100	100
Entreprises 1900 (G)	600	500	800
Structures régionales 200 (H)	50	50	100
Ventilation de l'effort Global 2400 MF (I)			
1983 565	160	135	270
1984 885	320	195	370
1985 950	270	320	360
Total .... 2400 MF	750 MF	650 MF	1000 MF

Key: (A) Areas of action
(B) Machines Robots Perirobotics
(C) Components Sensors Actuators
(D) Engineering Pilot action Software Product study CAD link And so on
(E) Type of organization
(F) Major research organizations
(G) Enterprises
(H) Regional structures
(I) Allocation of the overall 2400 MF investment

Objectives and Proposals

Objectives

Equilibrate the trade balance 60 to 100 percent
Improve productivity (12-18 percent per year) and contribute to the flexibility of manufacturing industries
Assure good socioeconomic integration

Proposal 1 - Instrument: Interministerial Robotics Committee
- Federate partners, from researcher to user
- Manage, coordinate, and orient actions with technologic and industrial goals
- Supply
- Demand

Proposal 2 - Hubs of competence
- IPA Besancon
- Minirobot Toulouse
- And so on

Proposal 3 - Research
- Major programs
  - Reinforce the Advanced Automation and Robotics program (ARA)
  - Components
  - Economic and social sciences
  - Automation of continuous processes
  - Link the large computer technology, electronics, mechanics, and optics (laser) programs
- Development
  - Specific topics and ad-hoc actions
    - High performance actuators
    - New robots (mobile robots)
    - Perirobotics

Proposal 4 - Pilot operations
- Integration of design and automation for new products
- Flexible assembly shops

Proposal 5 - Training
- Familiarization for secondary education teachers
- Robotics internships for permanent training
- Strengthen specialized options in engineering schools
- Industrial internships under SSCR and SCIR control

Proposal 6 - Information and promotion
- Concentrate actions on AFRI and AFCET
- International cooperation

Proposal 7 - Component qualification

Centers for component testing and evaluation

Methods for evaluating robotics needs

Generalization and standardization of components (AFNOR)

Proposal 8 - Industrial structure and organization

Collaboration of major partners in the industry

Create companies for robotics service and consultation and for robotics engineering

Contribute to the organization of recommendation-distribution networks

Opportunity studies and automation plans

Proposal 9 - Financing

Correlate supply and demand

Incentive and support measures

- Three-year fiscal amortization
- Subsidies for incorporation investments
- Extension of low interest loans

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CSO: 3698/80

FACTORY AUTOMATION

ALFA ROMEO, MILAN POLYTECHNIC DEVELOP INDUSTRIAL ROBOT

Milan INFORMATICA 70 in Italian Jul-Aug 84 p 14

[Excerpt] The Mechanical Engineering Department of Milan Polytechnic has developed a robot prototype named "Gilberto," with six degrees of freedom, powered by electric motors with a relatively simple mechanical transmission and control software run on a microcomputer. Alfa Romeo's Research Department has contributed to the feasibility analyses and applied development of this sophisticated product, also taking out a patent on technological innovation of control of the mechanical structure, jointly with Professor Rovetta of Milan Polytechnic. The link between university laboratory research and the applied industrial product sometimes seems faint because of the complexity of transforming the theoretical results of a study into an industrial product. Alfa Romeo's Research Department considers the research robot's application in the automobile sector to be a linking factor between the industrial product and the scientific study making it possible to forecast the function of robots in the factory of the future.

The link between the laboratory robot developed jointly by Milan Polytechnic and Alfa Romeo Auto and the industrial product seems quite obvious and, also consistent.

The industrial product is comprised of a Cincinnati T3726 robot which, in a demonstration of robotized grinding of engine heads, provided evidence of its high applied flexibility, deriving from six degrees of freedom together with the unique shape of its triple-jointed wrist. Such features make possible high performance even in the case of limited space and exact precision requirements.

These robots are also supplied in complete robotized systems by Mectron Robotica Technologica, which develops systems in the field of automation of mechanical operations (welding, milling, drilling, grinding, gluing, manipulations). In fact, the Cincinnati robot, which has a reputation for being one of the most sophisticated and reliable machines, and the laboratory robot can be hooked up to each other, with a subsequent exchange of information and

data on dynamic behavior. Various operating conditions can be analyzed separately by the sensory systems of the two robots, whose operations are linked through the exchange of information provided by computers.

11915
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FACTORY AUTOMATION

SWEDISH DEMONSTRATION PROJECT FOR ADVANCED FLEXIBLE ASSEMBLY

Stockholm NY TEKNIK in Swedish 4 Oct 84 p 58

[Article: "Factory of Tomorrow"]

[Text] One of the world's most advanced systems for flexible automatic assembly is located at KTH (Royal Institute of Technology), the technical university in Stockholm.

The system converts automatically for the production of different products. Thus, no human hand is needed to change tools and peripheral equipment.

At one end of the line, the robots assemble air motors.

At the same time, robots at the other end of the line are preparing to assemble an oil pump for home heating.

The fixtures for the different parts are changed as are the transferring arms and parts of the peripheral equipment. Everything is controlled by several coordinated computers.

American Circus

The facility looks like an American circus where there are several rings, with different acts appearing in each ring.

The assembly system is not without circus-like elements of surprise.

As an example, an Asea robot approaches a part-feeder and smacks its output channel to remove any air motor blades that may be caught.

As another example, when one of the robots has tried unsuccessfully five consecutive times to put a part into its fixture, the robot gives up, takes the part and fixture in its claw, places them on a junk heap, and then continues with the next operation.

Open For Industry

This system was built as a demonstration unit for industry. It was constructed by the institute, in cooperation with IVF, the Institute for Engineering Research. IVF is a research institute that is supported half by the state and half by the industry.

Researchers can use the system to test new ideas and partial solutions. The philosophy is that the system should be self-converting and, to a certain extent, self-repairing. In cooperation with the industry, researchers are conducting projects in which various products are assembled. The facility can operate unattended at night.

The system has already made an impression. Last summer a group of foreign researchers and writers for technical journals were given a short preview.

The foreign trade journals then praised this effort to construct such a bold system to such an extent that the researchers had to blush. The project leader is Anders Arnstrom of IVF.

9336
CSO: 3698/184

FACTORY AUTOMATION

FMS CELL IN OPERATION AT SWEDISH TOOL MAKER

Stockholm TEKNIK I TIDEN in Swedish No 4, 1984 p 20

[Article: "Flexible Manufacturing Systems Based On Industrial Robots"]

[Excerpts] Flexibility!

That is a word that receives genuine respect in today's engineering industry.

Much research and development is now being devoted to machine and tool systems that are capable of changing rapidly from one type of production to another.

For shops with many different, short production runs on their program, much is to be gained by having shorter setup times.

FMS Cell

STU (Technical Development Board) has a separate unit precisely for flexible manufacturing systems. Seco Tools in Arboga has been implementing one concrete example of STU's results for some time.

Seco Tools is a Swedish export firm with about 1,800 employees. It manufactures cutting tools, primarily.

Seco Tools

Several years ago when future manufacturing technology was being discussed, it was decided that one production cell should be able to perform all stages of production through the finished product.

The FMS cell at Seco Tools is an example of this concept in that it performs all tasks within a certain area of production from the input of raw materials to the manufactured part, ready for hardening.

Twelve companies produced equipment for the cell. Saab Automation AB of Jonkoping had overall responsibility for the unit.

Less Time

Mille Clareus, local manager of Seco Tools in Arboga, said:

"Our goal is optimum storage times and shorter throughput times, which means smaller batches."

"With conventional equipment, the setup time is 4 to 5 hours. With our new FMS cell, it is only 4 to 5 minutes. Thus, there is an enormous reduction in the setup time!"

In addition, 4 to 6 operations are performed on each part, while the parts are stored between operations. With the new cell, the entire process utilizes one operation!

Payoff In 3 Years

Total investments for the equipment were about 4.5 million kronor. It is believed that the equipment will pay for itself in 3 years.

The cell consists of a five-axled multioperation machine (which accounted for half the investment costs), a robot, a circular feed device for pallets, a burring station, a microwave labeling system, and control systems for the multioperation machine and the robot.

Raw Materials On Pallet

A pallet with raw materials is fed into the system, along with a label containing information on which product is to be produced. The correct software is then fed into the control systems of the robot and the NC (numeric control) machine. The robot can burr parts while the multioperation machine is involved in finishing, which does not require use of the robot.

In this way, 60 different parts can be produced by the cell with automatic setup and automatic tool changing.

The cell also contains various built-in safety systems to prevent breakdown. Quality control is also built in.

If the circular feed device is loaded with three full pallets of raw material, the cell can operate for 15 hours without manual intervention.

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FACTORY AUTOMATION

ORGANIZATION, ADMINISTRATION OF FRENCH MODERNIZATION FUNDS

Paris MICRO ET ROBOTS in French Nov 84 pp 56-57

[Article by Ph. Grange: "A Fund With No End?"]

[Text] It's all right to modernize! If you have the means...

"Modernizing" or rather "innovating" are among the leaders in the hit-parade of demagogico-political words, as they can be constantly repeated or will justify sudden landslides in the economic and social landscape. Depending on whether they are seen from the local company or small or medium-size firm or industry, or through the implacable filters of financial and economic health indicators, their content will never produce the same rashes. Businessmen, therefore, have no choice but to assess themselves both at micro and macroeconomic level, in order to avoid the sanction of failure. The constant vigilance warranted by free market laws is such that we can count on the fingers of one hand the businessmen that could claim today that they are serene in the face of competition, markets, the financial and social costs of their operations, their productivity and, in particular,... their products!

All these factors are feeding a certain "entropy" of insecurity, and all these projections and expectations must be accepted. Tautological as this introduction may be, it does show that these two words--modernization and innovation--are both the engine and the fuel of the economic machinery.

The Optimum Path

After drawing attention to these general considerations, we can define more precisely the components that will provide a balancing point to the company, as far as its "good health" is concerned: a strong product, an adequate production plant, sound finances and a clear social policy. But, as we just said, this pause in unstable equilibrium must move along as time goes on and trace an "optimum path." Indeed, the components we just listed are put back into question automatically, if only with respect to competition, new technologies, market shifts, the erosion of demand, etc. And, knowing that it takes two years on the average to set up a new workshop (including feasibility studies, financial package and installation), we realize how steady managers' expectations must be.

Therefore, it appears essential to follow a method when modernizing. The ability of a company to reach this point of equilibrium--and to want to retain it for some time--therefore helps the financial organizations to which a company has recourse to get an idea of the dynamism and "earnestness" of that company: these are those who succeed (on the average, for all sectors, 20 percent of the companies account for 80 percent of the activity of their sector!).

In addition to the investments required for traditional equipment or again for buildings, it is the modernization program of the production process that will monopolize the businessman's attention. To modernize, the businessman needs money... Equity capital, new issues of capital, bank loans are, if not obvious, at least immediate although inadequate sources. We should also forget about inexistent subsidies and consider only strategic and promotional aids. The first group includes the FIM (Industrial Modernization Fund, funded by the CODEVI [Industrial Development Accounts]) and the CODEX [Export Development Committee] (supervised by the Ministry of Foreign Trade and designed to assist export-intensive companies); these aids are paid back at a preferential interest rate. The second group includes the CPI, i.e. the industrial policy credits (usually managed by the regions) and the DAP credits (credits for the development of production automation--now being reorganized--which are granted by the General Directorate of Industry).

The FIM

In a decree dated 2 August 1984, the ANVAR (National Agency for the Implementation of Research) was made responsible for the management of the FIM (Industrial Modernization Fund), for which it is supervised by the Ministry of Industrial Redeployment.

According to an Anvar official: "The golden rule for small or medium-size firms or industries is to keep in touch with regional delegates of the ANVAR and the DRIR (Regional Directorate of Industry and Research). A more ambitious small or medium-size industry, or a larger one, should also keep in touch with the supervising directorates. But often the decisive factors are the businessman's personality, his 'weight,' his relations." The ANVAR will take care of the more technical and the DRIR of the more "political" aspects of modernization. But, whether at regional or national level, one administrative constant is a bother, not to say a nuisance: the preparation of an application. Actually, we should say "applications." This is where the shoe pinches: although a simplification is currently planned, the businessman must still comply with the formal requirements of the organizations to which he applies. Yet, this administrative "purge" has its good side, as it forces him to explain, to argue and, retroactively, it provides a better understanding of the object of the application. Also, those who "know how to present their projects show that they have them under control," and therefore have the advantage of being credible a priori.

In addition to financial statements (balance sheet, etc.) which can be included in the appendix, the businessman must prepare a basic application that can be relatively short (three or four pages) and which, alone, must present the company and convince without effort that the modernization... and the loan

are warranted. The remark often made to the applicant is that he does not rush to add something into the scales--as a complement to the aid he is asking for: an additional issue of capital, self-financing (based on his cash flow) and bank credits, as a rule. Actually, the (ideal?) average breakdown among sources of funds is one third from the company, one third from banks and the last third from the FIM.

Cash!

The decree of 18 July 1983, creating the FIM, provided that the latter could intervene either through direct loans to companies (technological participation loans) or through loans to leasing companies, which the latter redistribute to their clients at preferential rates (2 to 3 points below the market rates).

In 10 months, the FIM granted FF 5.5 billion in participation loans and leasing assistance to over 1,500 companies.

The cumulative total of allocations to the FIM, from its creation until the end of 1983, will amount to FF 11 billion. Is the FIM a fund with no end? Anyhow, about 15 percent of all applications were rejected. You understand that FMI aids, technological participation loans (PPT) and leasing do not cover the same applications.

Technological participation loans answer the need for considerable modernization, and therefore involve large amounts. In allocating them, no sector is given preference. Each project is studied by a team consisting of one reporter, one financial expert from the banking sector and one industrial expert. The advantage of such a team actually resides in the presence of the latter expert who--as an auditor--can provide general advice to the businessman (evaluation of the risks involved, assessment of technological competence, personnel training, etc.). Another characteristic of technological participation loans is decentralization: indeed, 80 percent of these loans were made through a regional procedure. The rate of intervention, compared to the overall amount of the modernization program, is 45 percent on the average. In this case, considering the rule of the three thirds enunciated above, we become aware that the FIM is making up for the chronic weaknesses of banks and companies.

As for leasing, it is a "sharp" tool: actually, an operation will often be decided within... 48 hours! You understand that this tool is intended to finance the purchase of a single piece of equipment or machine, not that of a workshop or cell. The type of products financed through leasing are given in a generic list that stresses the desire to modernize (numerical-control machine tools, industrial robots, industrial and automatic data processing, computer-aided design and manufacturing, etc.). On 31 August of this year, one third of the FIM had financed acquisitions through leasing. In addition to its rapidity of implementation, leasing offers the advantages that, from the point of view of the state, the leasing organization shoulders the entire risk of the operation and that the good use of the funds is checked a posteriori by the ANVAR. From the point of view of the enterprise, leasing will finance the entire cost of the investment and does not weigh down the

Applications Approved From 1 September 1983 to 31 August 1984 - Breakdown and Amounts (in Thousands of Francs)

Category	Number of Applications	Amounts: Programs	Amounts: Loans	Percentage of Interventions
1. Technological Participation Loans				
- at national level	103	8,928,213	3,940,500	44
- at regional level	578	2,295,937	1,105,353	48
- conversion poles	39	947,318	374,491	40
Subtotal	720	12,171,468	5,420,344	45
2. Leasing	56	/	1,461,200	/
Total	776	12,171,468	6,881,544	/

balance sheet. Finally, from the point of view of the supplier, the equipment sold is usually paid cash. The 47 leasing companies approved by the FIM are therefore quite efficient instruments of modernization.

We might ask if the strategic aids managed by the ANVAR are limited quantitatively. One thing is certain, by allying the technical competence of this agency and the funds provided by investors, the state offers to businessmen a chance they should not miss!

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MICROELECTRONICS

ESPRIT FUNDS SOFTWARE, CIM RESEARCH BY BULL, DEC

Software Environment Development

Duesseldorf VDI NACHRICHTEN in German 12 Oct 84 p 34

[Article: "Electrical Engineering/Data Processing. European Software Aid"]

[Text] Within the scope of the Esprit pilot program, the Commission of the European Community (EC) is promoting the development of a software base for a "portable common tool environment" (PCTE). The consortium in charge of development is headed by the Bull Company (France), and also includes GEC and ICL (Great Britain), Nixdorf and Siemens (FRG) and Olivetti (Italy).

The goal of the project is to develop and implement a software system which can be used to generate modern software development environments. Environments generated by the system will be of value not only to the research facilities taking part in the Esprit program, but also to the European software industry.

Some of the salient aspects of the project are the portability of the basic system and the quality of the advanced user interfaces which employ modern desktop computers with raster display screens distributed in a network.

The project is to take shape over a period of four years. The budget for the first year is two million European currency units (ECU), of which amount one half is to be supplied by the EC and the other half by the participating firms.

Project development is being coordinated with other Esprit projects, in particular with the Eies (Esprit Information Exchange System), Graspin (Graphical Specification and Formal Implementation of Nonsequential Systems) and SPMMS (Software Production and Maintenance Management Systems).

Comau, Renault, DEC Research CIM

Munich COMPUTERWOCHE in German 12 Oct 84 p 4

[Article: "Sub-Project: "Computer-Aided Integrated Manufacturing". DEC to Participate in EC's Esprit Program"]

[Text] Munich (CMD). Within the scope of the European Community's Esprit program, Digital Equipment GmbH of Munich will participate in a computer-aided integrated manufacturing (CIM) project.

According to the company, the German DEC subsidiary will contribute approximately 3.4 million European currency units (ECU) to the CIM project which will cost a total of 12.8 million ECU. Twenty five percent of these funds would be supplied by the EC Commission, with the remainder provided by the companies in the consortium.

Although DEC declined to name the other members of the consortium, information in Brussels indicates that the consortium's members include DEC and Renault Automation S.A. under the leadership of the Italian firm of Comau (Fiat Group, Turin). In addition, both DEC and Comau are to award subcontracts to the Technical University of Turin and the University College of Galway in Great Britain.

According to Willi Kister, manager of DEC, the consortium's project will lead to a series of standardized and publically available systems which will facilitate the introduction of computer-aided integrated manufacturing systems by European industry. In addition, said Kister, the project will make it possible for the information industry to manufacture a series of compatible products which will be competitive on the world market. Details of the agreement are scheduled to be made public as early as October of this year.

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CSO: 3698/175

MICROELECTRONICS

THOMSON SEMICONDUCTOR MAKES PROFIT IN LAST QUARTER OF 1984

Paris ELECTRONIQUE ACTUALITES in French 16 Nov 84 p 29

[Article signed J.P.D.M.: "Thomson Discrete Semiconductors Out Of the Red"]

[Text] The Discrete Semiconductors Division of Thomson Semiconductors will stop losing money during this last quarter of 1984, and should achieve sales of close to one billion francs for the year as a whole. This marks the completion of the division's first stage of evolution since June 1981, a stage aimed, on the one hand, at achieving profitability and, on the other hand, at giving the company an international dimension. Progress in 1984 can be termed exceptional: whereas the discrete semiconductor market (optoelectronics not included) increased by 23 percent in 1984 (with price increases of the order of 8 to 10 percent), the division's sales increased by 60 percent over 1983, and its exports rose from 55 percent by the end of 1983 to 70 percent by the end of 1984. From now on, for instance, Thomson is selling more power transistors in Germany than in France.

Priority to Profitability

Three years ago, the division's effort to reorganize and base its growth on sound structures took precedence over its effort to innovate. One of the results was the regrouping of discrete semiconductor operations in Tours and Aix-en-Provence (and out of Saint-Egreve, Villejuif and, to some extent, Alencon) and also at the Moroccan assembly plant (100 million parts per month, including 80 million of Zener). Another result was that some lines were abandoned: for instance, varicaps, plastic video transistors and certain linear transistors (including the 3055).

The sales force, in particular the export sales force, was entirely "redesigned." During that period, investments were finally made to strengthen existing operations rather than launching new ones. In 5 years, the division's sales thus increased from FF 300 million to FF 1 billion, merely by taking advantage of its latent forces.

It is now therefore possible to contemplate a stage of innovation and investment in new market niches. Actually, achieving a balanced position with respect to discrete semiconductors is far more significant than achieving a balanced position with respect to integrated circuits: next year, for instance,

the prices of MOS [metal-oxide semiconductor] integrated circuits can be expected to drop by up to 40 percent or more in new orders received. On the other hand, the prices of discrete semiconductors should not decline by more than 5 percent. Even if the quantities ordered increase by 30 percent for the former and 10 percent for the latter, 1986 corporate results will show growth for discrete semiconductors and, at best, stagnation for integrated circuits.

Resumption Of Investments For Innovation

The resumption of innovation investments at Thomson Discrete Semiconductors should take three main forms:

- adoption of modern high-voltage planar technologies for bipolar transistors and introduction of a family of modules;

- development of radiofrequency transistor families adapted to the market;

- creation of an ambitious MOS power-transistor program.

To these three major efforts should be added punctual efforts for GTO [Gate-turn-off] (announced today) and protective elements.

The 1985 investment for discrete semiconductors should thus catch up with the investments made by large international companies in this sector. (At Thomson Semiconductors, and including integrated circuits, it should amount to 40 percent of sales as far as payments, not just commitments, are concerned; the share of discrete semiconductors is smaller, but was not disclosed.)

Note that, contrary to many of its competitors who want to rely on the segmented-feed market to ensure their growth in power, Thomson Discrete Semiconductors is also relying on the motor-control market: only 2 percent of the motors installed to-date are equipped with electronic speed variators, and everything remains to be done. For components, however, Thomson-CSF does not expect any true growth in this sector to be felt before 1988 or 1989.

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MICROELECTRONICS

BRIEFS

SIEMENS MICROELECTRONICS CENTER IN DUESSELDORF--Siemens is going to build a microelectronics development center in Duesseldorf. Project cost is 50 million DM. In addition to Munich and Regensburg, the new center will be the third Siemens plant for integrated circuits in the German Federal Republic. The concept was developed in close coordination with the North Rhein-Westphalian Ministry of Economics. Computer-aided design methods will be used. [Text] [Duesseldorf VDI NACHRICHTEN in German 12 Oct 84 p 9] 8545

NEW AUSTRIAN ELECTRONICS INSTITUTE--Vienna (apa)--As of the beginning of 1985, a new research institute outside the university is to serve as a clearing site for new developments in microelectronics and applied technologies. This Institute for Applied Electronics is to fill the gap between university basic research and product development in the Austrian economy. The new institute is seen as a start-up site for the Austrian economy and as a "door opener" to university research. It should help to coordinate the federal government program funds for the advancement of microelectronics which are to be allocated to the economy as of 1 Jan 85. This was explained by Prof Dr Fritz Paschke, designated as the institute director, of the Vienna Engineering Institute, to which the institute will be attached. The new research institute is to be operated by the Microelectronics Company. Founding partners are the representatives of Siemens-Villach and Voest-AMI, the two Austrian micro chip producers, and scientists from various Austrian universities. Dr Norbert Roszenich of the Ministry for Science sees the Austrian Computer Company (OCG) and the Institute for Information Processing (IIG) operated by it as the model for the institution. The start phase of the project is being supported from budget funds. It is believed that further financing will come increasingly from enterprises, employers and employees. The Austrian Computer Company, for example, now requires only 30 percent in government funds after nine years of activity. [Text] [Munich COMPUTERWOCHE in German 5 Oct 84 p 52] 8545

NEW BULL MICROCOMPUTER FACTORY--Bull has just been given the green light for the construction of a plant at Villeneuve d'Ascq, in the north; the plant will produce microcomputers and work stations. An investment of about FF 200 million will be required. Two to three hundred employees will be transferred from the Marcq-en-Baroeul plant to the new production unit, and an additional 150 jobs are expected to be created. [Text] [Paris MINIS ET MICROS in French 5 Nov 84 p 22] 9294

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SCIENTIFIC AND INDUSTRIAL POLICY

SIXTH EUROPEAN AI CONFERENCE HIGHLIGHTS LACK OF SCIENTISTS

Munich COMPUTERWOCHE in German 5 Oct 84 p 43

[Article by Walter Reuter: "Industry and Science Interested in Artificial Intelligence: Lack of AI Specialists in Europe"]

[Text] Pisa. Galileo Galilei, Pisa's native son, helped to advertise the 6th European Conference on Artificial Intelligence (AI) which has just ended in Pisa. However in spite of Galileo, no spectacular new achievements were announced at the conference. Scientists and representatives from industry carried on spirited discussions and exchanges of experiences by telephone.

During the conference, which was held in the new congress center, it became clear that Europeans face the problem of having failed to recognise the great significance of AI technology until late in the game. An underdeveloped infrastructure has led to a lack of AI specialists, and it will be difficult to catch up.

A special program topic was therefore a discussion of education in the field of artificial intelligence. The re-elected president of the umbrella organization ECAI (European Coordinating Committee for Artificial Intelligence), Wolfgang Bibel of the Technical University of Munich, estimated that there are only about 50 experienced experts in Europe qualified to teach the subject.

The ECAI is trying to resolve the problem itself using its own ideas, and presented tutorials at the conference to introduce interested atendees to the subject of artificial intelligence, tutorials in which many students and industry representatives took part. Cooperation between science and industry was promoted through dialog and exchanges of ideas, and reports were presented concerning the EC's AI-oriented Esprit projects.

The ECAI suggested that industry set up its own AI groups under the direction of independent consultants. As a result of unfortunate experiences with internal training programs, it was recommended that close contact be established with small specialized firms and academic institutions such as the Gesellschaft fuer Mathematik und Datenverarbeitung [Society for Mathematics and Data Processing--GMD] in Sankt Augustin near Bonn. Dieter Bungers of the GMD proposed an AI trade fair at which interested representatives from industry would receive consultation above and beyond the "show effect". Symbolics (see box)

and Rank Xerox were represented at the conference as leading manufacturers of artificial intelligence systems. AI software houses from throughout Europe displayed their high-tech systems.

All in all the activities of the ECAI are a successful model for technology transfer, for which there is so often great demand. Training, the exchange of information and the development of new ideas within Europe with close cooperation from industry in this expanding field incorporates the risk, however, that the few available specialists will have little time left for important fundamental research.

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SCIENTIFIC AND INDUSTRIAL POLICY

STATUS OF SPECIFIC FRG HIGH TECH RESEARCH FUNDED BY BMFT

New Coating Technique Developed

Duesseldorf VDI NACHRICHTEN in German 12 Oct 84 p 28

[Article by Joerg Kieser and Michael Sellschopp: "Highly Cross-Linked Polymer Coatings with Selectable Characteristics. A New Coating Technique Using Microwave Plasma Polymerization"]

[Text] Polymerization of organic, gaseous substances via electrical discharge at low pressures was developed as long ago as the 1960's. First noticed and feared as a dirty side effect of high-voltage arcing in the non hydrocarbon-free vacuums of optoelectronic devices, the useful aspects of this phenomenon were soon developed.

Dilute gases consisting primarily of hydrocarbons were split by direct-current plasmas and later by high-frequency plasmas, and their reaction products were allowed to deposit and polymerize on surfaces located within the plasma. The thin coatings produced in this manner showed high chemical resistance and resistance to wear. All of these methods, however, had the disadvantage of very slow deposition rates which made them of little use in industry for coating large surface areas. It was only when attempts were made to use microwaves instead of direct-current voltage and high frequency to generate the plasma that it was possible to increase the deposition rate, and industrial coating applications could be considered.

Several years ago at this stage in the development of the new technology, which had been pursued largely at technical universities and research institutes, investigation into low-pressure plasma polymerization was begun at Leybold-Heraeus in Hanau, one of the leading firms in the field of vacuum process engineering and vacuum system design.

The aim of subsequent development work was to use microwaves to break down a gas in a container under vacuum and to precipitate its constituents onto large-area surfaces in the plasma. In addition, it was desirable to scale the process up for coating larger surface areas, and thus make the technique expandable for industrial applications.

These development efforts led to the design of a pilot plant in which 400 mm wide, flat substrates could be coated while passing through a plasma zone. It is also possible to coat thin plastic film up to a length of 300 m and a width of approximately 25 cm in a continuous pass.

The microwave coating process works as follows: A microwave field is allowed to pass through a vertical window, transparent to microwaves, in the vacuum chamber. The microwaves impinge on the gas inside the chamber over a large area such that a plasma is ignited inside the chamber in the vicinity of the window. A pallet containing the target substrate is passed horizontally through the plasma--which is parallel to the window--and coated within the plasma.

Chemically Resistant, Smooth Surfaces

Depending on the process parameters selected and the gas used in the process, coatings deposited by means of plasma polymerization exhibit a broad spectrum of characteristics, indicating that a wide range of applications should be possible. In general, the coatings are highly cross-linked polymer films whose characteristics lie between those of hard plastics and (when hydrocarbons are used as the reaction gas) amorphous carbon. They have extremely smooth surfaces (as long as the substrate is also smooth), are chemically very resistant and, when highly cross-linked, generally exhibit high thermal resistance. Examples of applications for coatings of this kind are optical functional and protective coatings, coatings to protect data storage media against mechanical stress and as protection against corrosion. In addition they can be used as electrical insulating films and diffusion barriers, or to improve adhesion, resistance to solvents, wettability and antistatic behavior. A further possible application for low-pressure plasma polymerization is in the field of immunobiology as hard plastic coatings for prostheses.

The pilot plant project, together with the development of the pertinent processes, was completed at considerable expense, and posed a not insignificant risk in the event of failure. It was made possible by generous funding by the VDI [Association of German Engineers] Technology Center in Duesseldorf and the Federal Ministry for Research and Technology.

Zeiss Develops Laser Components

Duesseldorf VDI NACHRICHTEN in German 12 Oct 84 p 28

[Text] The dramatically increasing use of high-energy lasers in medicine and in various areas of machining has led to a growing worldwide need for the associated optical components such as lenses, windows, mirrors, beam splitters, diffraction gratings and laser crystals. Until now, the extremely rigid material and processing requirements could be met almost solely by U.S. companies. In order to avoid growing dependence of German laser manufacturers on imports of these key components the Carl Zeiss Company, with financial support from the BMFT, is developing a range of optomechanical laser components.

New Surface Treatment

Duesseldorf VDI NACHRICHTEN in German 12 Oct 84 p 28

[Text] The Gottfried Guehring Company in Albstadt has developed a surface treatment process which deposits layers of highly wear-resistant mechanically-resistant material on cutting tools made of rapid machining steel. A three-chamber continuous system was designed for this purpose in which layers of various mechanically-resistant materials such as TiN can be economically deposited on a wide variety (shape and material) of substrates via the high-power cathode sputtering process, thereby significantly increasing the productivity of the products coated in this manner and the workpieces machined by them. Development of the process was begun three years ago and completed this past summer.

DM 320 Million for Sensor Research

Duesseldorf VDI NACHRICHTEN in German 12 Oct 84 p 29

[Article by Klaus P. Friebe: "A Future Only for State-of-the-Art Products. VDI Technology Center in Berlin Analyzes, Informs, Consults, Promotes in Field of Information Technology."]

[Excerpts] The structural change in German industry evident at the start of the 1970's, particularly as a result of the challenge presented by microelectronics, triggered deliberations within the Federal Ministry for Research and Technology concerning establishment of a technology center which would stimulate and assist the economy in a revolutionary way in the introduction of new technologies. The obligation of such an institution to remain neutral made the Association of German Engineers appear to be particularly well suited to such a task.

The special program "application of microelectronics", which turned the application of microelectronics around in the FRG from 1982 to 1984, is being expanded and continued via a "plan by the federal government to promote development of microelectronics, information technology and communication technology". The limits of economic application of microelectronics, for example, are currently imposed by sensors and actuators, the development of which has not kept pace with the rapid advances in microelectronics. As far as sensors are concerned, it is estimated that development of new designs would have to reach the 80 percent level in order to meet current demand.

Emphasis on Promoting "Microperipherals" Beginning in 1985

Consequently emphasis will be placed by the BMFT on promotion of "microperipherals" beginning in 1985, with the VDI Technology Center in Berlin in charge of the project, the goal of which is the development of economical microelectronics-compatible sensors and actuators. The federal government intends to make available around DM 320 million between 1985 and 1988 to fund this aspect of the program. As a result of the positive effect of indirect-specific promotion of the special program "application of microelectronics",

an indirect-specific approach is also to be used in the promotion of "microperipherals". However this complex technology also makes it necessary to initiate joint projects between research facilities and various firms in order to effectively make up the current shortfall and bring the field up to the level of international competition.

It appears that the plan of the VDI Technology Center in Berlin has been a successful combination of flexibility and market orientation while at the same time retaining proven strategies. An indicator of the success of the VDI Technology Center will be the extent to which firms can be given help for their own self-help, putting them in a position to technologically adapt on their own without additional state aid once they have been brought up to a high technological level. The methods of the VDI Technology Center for achieving this goal are:

- funding of projects for the development and application of information technology in products, particularly in small and medium-sized firms and in new firms;
- project-oriented assistance and consultation to achieve, among other things, business management and organizational changes;
- analyses and prognoses concerning technological development, questions of technological evaluation, qualification changes, trend shifting and the like;
- qualified information for users, those involved and the sociopolitical environment as well as initial training and further education both inside and outside the firm.

Electronically-Controlled Engine

Duesseldorf VDI NACHRÍCHTEN in German 12 Oct 84 p 30

[Article by Hans Joachim Wendt: "Internal-Combustion Engine Without a Crankshaft. New Technologies are Never Risk-Free--Technical and Economic Aid is Much in Need."]

[Text] "Promot" is the name of the prototype of the first programmable, electronically-controlled internal-combustion engine with variable stroke and no crankshaft. The project was funded by the Ministry for Research and Development within the scope of the special program "application of microelectronics", and was carried out with assistance from the VDI Technology Center in Berlin.

The engine consists of one or more cylinders without crankshaft and camshaft. The cylinder houses a movable piston connected to a toothed rack. The rack is rigidly held and drives an overrunning clutch via a drive pinion gear. The rack is also connected to an electronically-controlled electric motor generator. The piston with rack also acts against stored compressed energy. An electronically-controlled blower supplies fresh air through inlet valves or slots. Fuel is supplied via an injection system. Exhaust gas is discharged through outlet valves or slots.

"Promot" is designed to be a revolutionary new drive system with numerous applications. It is characterized by:

- economy of operation because it can be programmed for specific drive applications
- economy of operation because it utilizes adjustable stroke, compression and firing point which can be controlled and optimized while the engine is running, thus minimizing fuel consumption
- idling and a transmission are not needed because engine speed can be controlled independently of torque
- various different fuels can be used because the compression and ignition of the engine can be optimally programmed for the type of fuel used
- simpler design through use of fewer moving parts.

All engine functions are microprocessor-controlled. The microprocessor uses sensors to determine instantaneous piston position and engine temperature, and calculates the required amount of fuel and the fuel/air ratio based on the demand values for engine speed and torque, while engine speed is increased electronically from zero to nominal speed. The flow of fuel used is also optimized electronically via variable compression and ignition. The specific operational data are stored in the memory of the microprocessor in the electronic control system. These data comprise tabular values for the various speed vs. torque characteristics. Additional parameters required to ensure that the fuel/air ratio is correct and that the ignition system operates properly when the engine is started are the oil and cylinder wall temperatures which are detected by sensors and used to optimize the fuel/air ratio for both a cold and a warm engine.

Prototype Development is Completed

The project was able to be greatly accelerated due to the availability of assistance from the VDI Technology Center in Berlin within the scope of the BMFT special program "application of microelectronics". Three factors were given primary consideration:

It was possible to bridge the financial gap in development of the prototype.

VDI assistance meant that additional experts were available to help in project development.

It was possible, through public funding, to complete the project more quickly.

The simplified contract awarding and accounting procedure was beneficial to the consulting firm of Weas which received funding for development of the project. It is precisely such small firms which rarely have the experience and manpower needed to handle the enormous administrative workload associated with publically funded projects. Occasional delays in the quarterly accounting cycle during the course of project development, however, were an annoyance. In this regard, improvements could be made for future programs involving aid to small and medium-sized businesses, because otherwise problems could occur in such firms due to a lack of initial capital resources.

Ancillary support measures during project development, however, were seen as entirely positive, particularly the support provided at trade fairs and exhibitions. Through many contacts with specialists in the field and interested parties, it was possible to achieve a high profile for this revolutionary new drive system technology. Both domestic and foreign interest among specialists in the field continues to grow, thanks to the support of the BMFT, the VDI Technology Center and the firm of Dr Prommer Consulting, both during the Microtronik exhibit at the 1984 Hanover Trade Fair as well as since the introduction of the first prototype in Hamburg in January 1984. This success has encouraged the initiators of the project to undertake preparation for series manufacture and marketing of the "Promot" drive system.

After making use of the special program "application of microelectronics", attention is now focused on founding a company. Within the scope of the model experiment "technology-oriented company start-ups" set up by the BMFT, and with the support of the VDI Technology Center, plans are under way to found a company with the goal of series manufacture and marketing of the programmable, electronically-controlled internal-combustion engine as a stationary source for the generation of electric power and as a special-purpose drive system.

The initiators of the project understand that a series of technical as well as economical hurdles must still be cleared before the invested capital begins to return a profit.

Venture Capital for Manipulator Research

Duesseldorf VDI NACHRICHTEN in German 12 Oct 84 p 31

[Article by Norbert Schlimm: "Special Tasks for Manipulators. Unbureaucratic Aid and Support are Features of the Aid Program for Company Start-Ups."]

[Text] Ro-Ber was one of the first companies to move into the Innovation and Founders' Center in Berlin in the fall of 1983 with the aim of developing, manufacturing and marketing revolutionary new manipulating systems. For four years, the founder of the company had been manager of the German subsidiary of Unimation Inc., the world's largest manufacturer of industrial robots with a nearly 40 percent share of the world market.

The experience in the installation of robots which he gained in that job, as well as the existing market for industrial robots, were sufficient for the founder of Ro-Ber to dare establish his own company with his own concepts. Ro-Ber has targeted the special applications sector of the manipulator market which accounts for small numbers of manipulators. Here, a small, flexible company can safely hold its own against its numerous competitors. Ro-Ber has specialized in simple, intelligent solutions for specialized applications in the field of manufacturing. This direction of company development seems to be confirmed by the previous interest and cooperative desires shown by larger companies. In a relatively short time, Ro-Ber has been able to put together a staff of 13 employees.

Success to date, however, would not have been possible without federal aid and support. This innovative development project was made possible in particular by the model experiment "technology-oriented company start-ups" (TOU) set up by the BMFT, because the company alone could not put up the necessary capital. In the preliminary phase of the company's founding, contact with the VDI Technology Center in Berlin was established with the aid of a commercial consultant on company start-ups. The technically innovative content of the project had to be clearly presented to the VDI Technology Center. Because Ro-Ber was one of the first applicants for such aid, the company was able to experience the start-up phase of the TOU aid program. Ro-Ber had to present its market strategies as well as a clear method of financing.

It is probably difficult for any company founder coming from the private sector to imagine how one quickly and at low cost goes through the concept and application phase, finally arriving at a decision. Here, the aid of the VDI Technology Center in Berlin in helping the individual see things clearly as well as its support in doing the right thing are indispensable. In the meantime, Ro-Ber is in phase II of the TOU program. The parallel processing of orders which has been going on for some time would certainly not have been as successful had we not received the unbureaucratic support of the VDI Technology Center in Berlin.

Requirements for Receiving Venture Capital

Duesseldorf VDI NACHRICHTEN in German 12 Oct 84 p 31

[Article by Wolf-Dieter Oels: "Electronic Insurance Against Overvoltage Peaks. Market Studies and Literature Research Ease Entry into Self-Employment."]

[Text] The need to keep information processing systems up and running even in environments plagued by interference motivated the founding of the Telem company in Witten. Telem's product idea is called "Protectronic"--protection of electronics. "Protectronic" is an artificial word which describes an area of electronics which is growing in importance.

The significance of "Protectronic" was important enough to the VDI Technology Center in Berlin for them to give their know-how support to Telem within the scope of the special program "technology-oriented company start-ups" (TOU) set up by the Federal Ministry for Research and Technology.

Phase I of the TOU program began with comprehensive market studies and literature research, as well as initial functional model developments. Preparation for the important phase II, in which actual development work begins, takes some time, however the result is a thoroughly thought-out company concept which covers not only technological assessment, but also overall five-year planning from financing to detailed marketing plans.

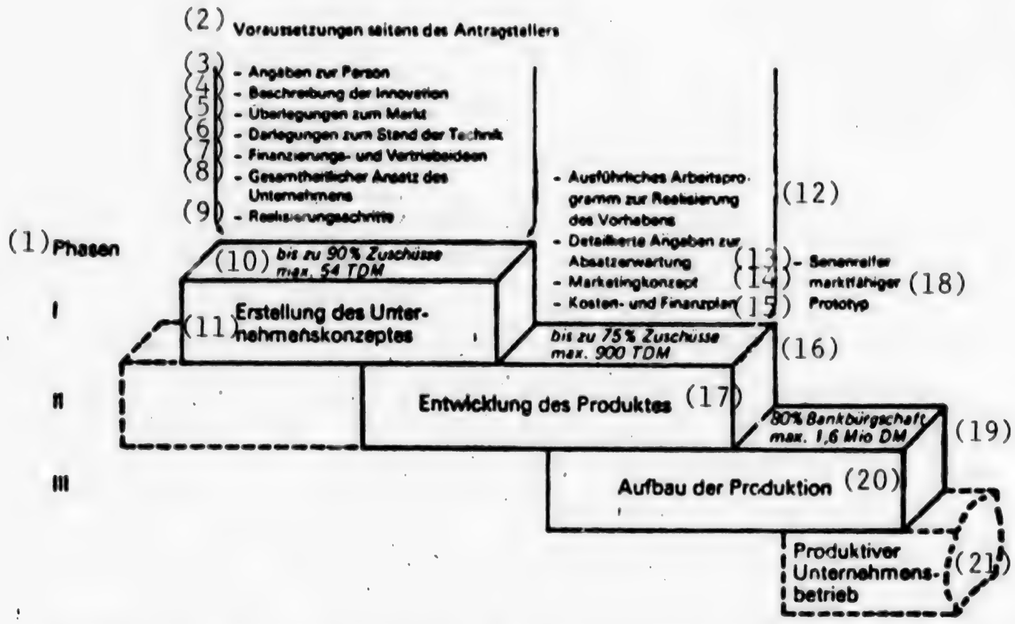

Figure 1. By 1987, the Federal Ministry for Research and Technology will have funded young technology-oriented companies in the regions of Berlin, Hamburg, the Ruhr Valley, the Saarland, Karlsruhe/Pfortzheim and East Bavaria, as well as nationwide projects based on microelectronics. (Drawing courtesy of the VDI Technology Center, Berlin)

Key:

1) Phases
2) Requirements to be met by applicant
3) Personal information
4) Description of innovation
5) Market considerations
6) Description of the state of the art
7) Financing and marketing ideas
8) Overall approach of company
9) Steps in project realization
10) Grants of up to 90% max. DM 54 thousand
11) Preparation of Company Concept
12) Detailed work schedule for realization of project
13) Detailed information on marketing expectations
14) Marketing concept
15) Planning of costs and finances
16) Grants of up to 75% max. DM 900 thousand
17) Product Development
18) Marketable prototype ready for series production
19) Bank security note up to 80% max. DM 1.6 million
20) Establishment of Production
21) Productive Company

A checked and evaluated concept such as this one which is supported by the VDI Technology Center is of considerable importance to anyone wanting to found a company, particularly during discussions with financial and credit institutions. Without the federal TOU program, the "Protectronic" concept would have had to be sold to outside investors for financial reasons. Most offers of venture capital come from abroad, whereby investors within the FRG continue to look for suitable projects.

However the TOU special program enables and even helps the founder of the new company with the technological know-how to retain the majority of the interest in his company in order to retain control over it. Those project proposals are likely to be funded which unite experience in technology with entrepreneurial drive, coupled with the creation of new jobs.

Telem's "Protectronic" concept was able to meet these stringent requirements, and has in the meantime developed into a mature company which has created attractive jobs in the structurally weak Ruhr Valley region. A complete line of overvoltage protection products will be displayed for the first time at the "Elektrotechnik '84" [Electrical Engineering '84] trade fair in Dortmund from 17 to 20 October 1984. The company will exhibit overvoltage protection devices for use in signal and power supply lines which are ideally suited to installation in existing systems.

The "Protectronic" line of products is characterized by ease of installation and the ability to safeguard entire systems via one ground bus. Prospective customers targeted by Telem are installers of electrical equipment, customer service centers, marketers of EDP and telecommunication equipment, users and manufacturers of EDP systems and office organization equipment, owners of technical laboratories--also in the field of medicine--as well as all those who have already suffered the effects of overvoltage peaks or those who want to avoid them in the first place.

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SCIENTIFIC AND INDUSTRIAL POLICY

EEC PROPOSES EIGHT RESEARCH PROGRAMS FOR 1984-87

Paris AFP SCIENCES in French 8 Nov 84 pp 28-29

[Text] Brussels--The EEC's 10 research ministers meeting in Brussels on 6 November advocated a progressive rise in European Community expenditures on research despite budgetary constraints, it was indicated by diplomatic sources at the conclusion of the meeting.

The 10 ministers defined eight research programs under the general 1984-87 outline program; final decisions on these research programs are to be reached at their next meeting on 19 December. Between now and then, the European Commission has been asked to draw up proposals for financing these programs. The Commission had initially estimated the necessary funding at 7.3 billion ecu's [European Currency units].

However, because of the EEC's 1985 financial straits, wherein it is already evident that available resources will not suffice to cover total expenditures, the research budget will have to be limited. The credits allocated as of now in the draft 1985 budget amount to 585 million ecu's. Nevertheless, the 10 rejected a ceiling on these expenditures as was advocated by Bonn and London and undertook to increase them gradually.

The proposed eight research programs concern: Protection against radiation; fomenting of scientific cooperation and exchanges; biotechnology; safety of reactors; thermonuclear fusion; non-nuclear energies; basic technological research on applications of new technologies ("Brite" Project); and radioactive waste.

The 10 expressed approval of the development of video communications circuits between Community institutions and the member governments of the EEC. An experimental videoconference will be held on 13 November in Paris. Four two-way videoconference links will be set up between the French capital and The Hague, Frankfurt, Rome and London.

In another development, Italy and Denmark opposed the choice of the city of Grenoble, advocated by Paris, London and Bonn, for the installation of the future synchrotron radiation laboratory, the cost of which is estimated at 1.2 billion francs.

The two countries opposed are each seeking to have the synchrotron installed within their own borders. Italy stated it is prepared to pay 50 percent of the construction cost if the laboratory is built in Trieste, while Denmark proposed the city of Riso, southwest of Copenhagen.

Mr Hubert Curien, [French] minister of research and technology, intervened in this discussion to state that the final decision had not been made and that it was not within the province of the EEC, but rather that of the Governments involved in this project. He nevertheless underscored the importance of an agreement in principle on the Grenoble site that has already been reached among the three principal suppliers of the funding, which are France, the FRG and Great Britain.

A coordinating committee of the Governments committed to the operation will meet on 5 December to decide on the financing and the site.

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CSO: 3698/213

SCIENTIFIC AND INDUSTRIAL POLICY

FRENCH RESEARCH MINISTER ON POLICY, TECHNOLOGY TRANSFER

Paris MICRO ET ROBOTS in French Nov 84 pp 42-45

[Interview with Hubert Curien, French minister of research and technology: "Research in Question" by Ph. Grange and J.-C. Hanus; date and place of interview not given]

[Text] If the influence of a minister can be judged by the size of the budget allocated to his ministry, then Hubert Curien, calling his "an island of prosperity in an ocean of austerity," has every reason to feel satisfied. The former president of the ESA [European Space Agency] intends to use it judiciously...

[Question] What changes should your appointment bring about?

[Answer] The prime minister proposed to the president of the Republic the creation again of a Ministry of Research and Technology as a full-fledged ministry in its own right. This is an indication of the very decided importance being attached to research and technology in our country. This has already been translated by the special protection accorded to research in the preparation of the 1985 budget, marking the Government's profound desire to ensure the unimpeded advance of research toward the development of leading-edge technology. We want to have, as Mr Fabius has so clearly put it, a modern country. Its modernization depends on high-quality research and a prosperous technology. At issue is a crucial orientation of government policy.

[Question] What are your reasons for having accepted this responsibility?

[Answer] I have always been interested in science and I have also had occasion to become involved in scientific policy, particularly when I was with the CNRS [National Scientific Research Center]. Then, to be perfectly candid, I have had the pleasure and honor of heading a major center of advanced technology. When Mr Fabius asked me if I could accept this post, I did so without the least hesitancy, because I think it is an assignment in which service can be rendered to the country, to the scientific and technological communities. Besides, I felt--perhaps I lack modesty--that the fact of my knowing many scientists and industrialists would make my job easier and make me more effective in it.

[Question] That was not necessarily the case of your predecessors...

[Answer] No. But my predecessors certainly had one advantage over me: They were more conversant with the political environment. This advantage disappears with time...

[Question] What relations can there be between science and politics? Is there such a thing as a "leftist policy" with respect to research?

[Answer] Let's be very clear. There is no such thing as a rightist science and a leftist science. There is a science--period. I stand firm on this point. Let's not talk nonsense of that nature, as it merely leads to Lyssenko and other cases which you have undoubtedly not forgotten. There exists but one science, and that is knowledge of the universe, of matter, and of universal processes.

On the other hand, we can talk about a science policy, which can be leftist or rightist. And, in this regard, it can be asserted that, since 1981, the president of the Republic and its Governments have consistently affirmed their very strong desire to encourage science, as I said a moment ago. The present government is convinced that science is an absolutely indispensable activity for our country, which must attain the level of the other technologically very advanced countries, namely, the United States, Japan and other European countries. In this sense, I can answer your question: A policy is being implemented by our present Government--a leftist government--which is aimed essentially at the modernization of our economic machine. We would like to think of this view of the development of science and technology as being a consensus of our citizenry as a whole, irrespective of individual political leanings or convictions.

[Question] Can science and technology be decoupled from each other?

[Answer] No, that would be a serious mistake. A ministry of science without any responsibilities on the side of technology would have conformed to an outdated policy. But it is not always easy to marry the two... This research effort is costing a lot: Around 100 billion francs for next year. Everyone must realize, therefore, that there are two essential priorities: On the one hand, we must improve our knowledge of the world in which we live--the living as well as the inert--of the universe; and on the other hand, we must take advantage as rapidly and as effectively as possible of all gains made in science to develop a technology for manufacturing products and systems that are somewhat better and cheaper than those of the others. If you succeed in one but not the other, you have simply not succeeded.

[Question] Does this leftist policy also envisage a need for European cooperation, for a North-South technology transfer?

[Answer] It is clear that the European concept is presently taking on more and more significance from the standpoint of science and technology; and indeed we have chalked up some very outstanding European successes in these

domains. It is easier to build the Europe of science than the Europe of sheep, since its people are much more ready to reach a mutual understanding. The interests of industry are very important, but less immediate than those of agriculture, which are always very pressing. We have already succeeded to a great extent in the building of scientific Europe, whether it be with regard to nuclear, aeronautical or space programs: The Europe of scientists and technicians is truly well under way. It must be at one and the same time cooperative and competitive with the other major regions--essentially North America and Japan. No intellectual barrier must exist across either the Atlantic or the Pacific. The Americans and the Japanese are well aware of this. They prefer to have well-structured and equally weighty partners for the joint implementation of major projects: Accelerators, space telescope, etc. But the more one gets into application the more one enters into competition. From this standpoint, a European market--for rockets, for example--is an excellent springboard for the capture of other markets. There are thus two aspects to this concept of Europe as a necessity: On the one hand, that of a Europe as a structured and very cordial partner; and on the other hand, that of a Europe as a very strong competitor--by virtue of already having its own market--capable of capturing a share in the markets of the others. There are intermediate domains between applications of a commercial nature and those of a purely scientific nature: Meteorology is one of these. Here again, it is evident that if France had wanted to undertake the building of a weather satellite 10 years ago, it could have. But it would have cost us five times more. Such a satellite, covering half the surface of the globe, was of interest to all of Europe. But it still had to be built and, having built it, an understanding had to be reached as to its operation and use. A European agreement--EUMESAT--has been put in place, which brings the meteorological partners of the different European countries together into a functional operating entity: Europe actually lives and breathes in that entity. From the standpoint of North-South transfer, France has consistently advocated a policy of cooperation with and aid to the Third World. How is this initiative to be undertaken? Alone or, on the contrary, with the other European countries? There are questions of language, economic influence, and political intent. We cannot wage a guerrilla war against our British or German neighbors in this or that African country. There are, nevertheless, certain types of initiatives that we can undertake in African countries having a culture and financial and administrative practices that are closer to ours; we feel that France is better positioned than others in certain countries. However, initiatives undertaken by the EEC or worldwide, through UN organizations, are of very direct interest to us. Numerous initiatives of this type are currently in progress. There is a domain in which we could very easily intervene on a European scale, namely, that of tropical medicine, for in Europe we have top-flight specialists in that field. We have decided to launch an initiative in that regard at our very recent meeting of research ministers.

[Question] In France, are the civil service regulations on research compatible with the new view as to the necessity of developing leading-edge technologies?

[Answer] I take the question to be: Is it compatible with mobility to make a civil servant of the researcher? My predecessors worked, subsequent to enactment of the basic law on research, to draw up improved civil service regulations pertaining to the research entities and researchers.

As for the entities, all of them must be given more staff and independence. My policy, in fact, is to give these entities free rein to enjoy their prerogatives in full. They are public institutions and they must fulfill their role as public institutions: They define their own internal rules and regulations based on the general guidelines we provide to them, but they remain masters of their own houses, provided they adhere to the checks and balances we have defined.

As for the researchers, we are reproached at times with having made civil servants of them without taking into account the "insecurity" of the researcher. The fact is that a researcher enjoys no less a degree of job security than an engineer. Under the regulations governing researchers before this reform, they were in contractual status of unlimited duration, so that the change is not a significant one. Its essential points are the training of teams and mobility within these teams. The problem that arises is with small teams that have not yet attained the full extent of their security: To abruptly change the team manager is risky; on the other hand, replacement personnel for small teams is not always readily available. The team as such will therefore be reviewed: If it is found that the only solution is to reinstate it with the same manager, we will do so, but then it will enter into competition with the other new teams. As to mobility, the worst thing is immobility with respect to topics of research, which is far worse than geographic immobility--the researcher who gets hung up on a topic and remains homothetically channeled by it--what I call "zerographic research."

[Question] Have you sensed a change in morale since 1981?

[Answer] During get-togethers organized by Mr Chevenement, we sensed that the researchers wanted to take part in the discussion, had things to say, did not raise issues with regard to employment status. Their basic concern is involvement in research that moves and, in the case of the young researchers, to be part of an efficient team that produces ideas and can quickly put those ideas to a test, especially by way of very modern equipment. This dialogue brought with it "a fresh breeze" and revealed the exact nature of the stakes for the country and for the researchers themselves. These hopes must not be dashed; we must not let ourselves be outdistanced by the American and Japanese laboratories. One of the prime points is that our laboratories must have available the most modern and most accessible data processing tools; the work of the researcher has greatly changed. The important thing is to be able to move as fast as do the others, to not spend precious time doing repetitive and commonplace computations that a machine can do in our stead.

[Question] Concretely, might one expect, for example, to find American developmental machines in CNRS laboratories?

[Answer] By all means, one might! We must be realists! This question compels consideration of two aspects of the matter: On the one hand, the development of our national industry and its advancement to a point of clear competitiveness with the industries of others--computers must be manufactured in France and sold abroad; and on the other hand, our laboratories must be well equipped. If there is a line of equipment in being that we decide not to develop ourselves immediately, and the need of which is absolutely evident, then we will buy it elsewhere.

We must not delude ourselves that in France we can do everything immediately and always!

[Question] Which sectors should be privileged?

[Answer] Among the sectors that we decidedly want to sustain, we have chosen electronics and data processing, on the one hand, to head the list and, on the other hand, biotechnologies. Taking all budgets together, not only mine but also that of Mrs Cresson, and the part the PTT will be able to allocate to the development of data processing, there is a very notable increase in 1985 over 1984. It is therefore a funded priority.

[Question] Where does robotics fit into the picture?

[Answer] From the standpoint of public funding, you are not unaware, of course, that systems have been developed which have contributed to "advanced robotics." Perhaps you will recall, for example, the Visiomat system--a bidimensional image-analysis system--now transferred to and being exploited by MATRA [Mechanics, Aviation and Traction Company], which is marketing it. Our work continues, therefore, in that sector, particularly through the Multipurpose Autonomous Robots Program.

We will undoubtedly find it necessary to implement an even more closely coordinated policy. The industrialists and laboratories may at times have the impression that the Government makes heavy outlays in those sectors---electronics and data processing--and that these outlays perhaps do not yield as much as might be expected, because they are somewhat dispersed; and, again at times,
certain small- and medium-sized industrialists see before them a sheaf of public funding programs in which they scarcely share. We have agreed with our other colleagues in the Government--Industry and PTT, in particular--that we are going to try to simplify the landscape, without narrowing its scope, as seen from the industrial standpoint.

[Question] Are the industrialists making a dynamic approach towards research?

[Answer] Yes. I have no problem in this regard with the big firms. They are well aware that the research effort is entirely indispensable and they, moreover, have their own research laboratories. We will be examining together with them how we can best facilitate their task so that they can further increase their research outlay. But as regards the PMI's [Small- and

Medium-Sized Industries] the situation is certainly far from being ideal, perhaps because we really do not have a direct enough system. The known clientele is good, but the unknown segment of the clientele could be every bit as good. That having been said, the fact is that, despite the difficult economic conditions, the industrialists have already made a very large research effort. This must absolutely be recognized and they must be encouraged to go even further in that direction.

[Question] Would it not be possible to assign a laboratory to each PMI in any one geographical zone?

[Answer] Of course. That is very important. We would like for our regional correspondents to be able to further increase their initiative. There are some regions where we have not yet fully succeeded in this respect, but eventually we will. We would like to see facilitated in a given region the entry of all its industrialists into the spectrum of interlocutors it can have from the standpoint of research, technology and industry. We have already deployed an initial effort--that of simplifying and coordinating the application forms for aid, insofar as concerns the description of the firm, its financial condition, bank standing, etc.

[Question] Would it be reasonable to envision the equivalent of a SACEM [Society of Authors, Composers and Music Publishers] which would concern itself on a national level with the "rights of scientific authors"?

[Answer] Those scientific rights are called patent royalties. The question is interesting and important but has not yet been truly resolved, since patents do not cover everything and they are still arguable, for example, insofar as concerns software. The same is true in the food farming sector: It is not always easy to patent this or that new variety. Then too, a singer is not a civil service employee, whereas when a researcher researches, he is--in any case--paid. Researchers are not money-hungry. What counts most for a researcher is, for example, to be invited to New York to address 300 Americans. If he were asked to choose between that and a 13th month's pay, I believe he would not hesitate for one moment! The researcher is motivated by that sort of buoyant collectivity, and the one who finds is promoted. Research entities, on the other hand, are interested in a return on their investment. This is the operative factor in industrial developmental entities such as Bertin, for example. To do the equivalent systematically in government entities would seem to me a bit dangerous, since the researchers could then complain--which they are no longer doing--and with good reason, that they are being taken advantage of. This would have the effect of stifling many somewhat disinterested initiatives which experience has shown produce significant results. If a governmental body can realize a certain profit from its inventions, that is perfectly natural, but it is not its basic purpose. Even the most capitalistically-oriented countries do not operate that way. Of course, American universities receive industrial funds and work under contracts, but a substantial portion of their resources are provided by the government.

[Question] Are the transfer firms able to attract researchers--those up the line, to be exact?

That is an important point on which something remains to be done. Too few researchers installed in public entities are tempted to venture out into private entities. This situation has improved but not enough. The reasons are many and must still be unraveled. This must be done at the earliest possble, with the youngest of the researchers; the older ones will follow. It is absolutely essential that researchers under age 30 in a university system or in a government laboratory not feel they are in a sort of cocoon from which they are afraid to emerge. They must be shown that what awaits them outside is not the Devil himself, and mechanisms must be found to put them in direct contact with the industrial milieu. It is essential that the universities--and especially they--accustom their students to interest themselves in industrial problems. But the inverse is also true: It is essential that the industrialists not, from their viewpoint as well, consider the university a milieu in which they are not entirely welcome!

[Question] Has regionalization gone by the board?

[Answer] The Government seeks and is acting to promote a very real decentralization. Contract systems, as well as state-regional plans, have been instituted; all of this is proceeding well. I would not want you to conclude, however, that there will be 22 research policies in France. Our size is not sufficient to permit the regionalization of an overall research policy. A national policy must be drawn up with the regions as partners. On this point the regional echelons in our confabs have been very active.

As to the problem of the specificity of a given region, it is a difficult one. We must avoid a "monocultural" situation. The Toulouse region is very wisely taking advantage of a specialization--aeronautics and space--to extend it over a broader base: Electronics, data processing, robotics...

[Question] Are there any branches of research that are short of manpower?

[Answer] Yes. Not enough technicians, engineers and researchers are being trained as yet in data processing, or for that matter, in electronics. It must definitely be recognized that the job market has greatly changed in 10 years, that our higher education and training must absolutely be adapted to this new reality. But neither blindly nor abruptly!

[Question] What would you like to leave as a final thought in this interview?

[Answer] It is essential that researchers take cognizance of the fact that research is being taken into account at the very highest level in our national policy, but also at regional policy levels and in the policy of every one of our industries. We are seeing to it that in every industrial group there are scientists of high standing with a say at the upper levels

of management. It is as important from the standpoint of the state, as from that of the region, as from that of the enterprise that the scientists be there and that they be heard. We will succeed in this, indeed we are succeeding. And this creates obligations for us...

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SCIENTIFIC AND INDUSTRIAL POLICY

BRIEFS

MORE ENGINEERS FOR FRANCE--The new French government under Prime Minister Laurent Fabius is planning a high-profile role for engineers in the new French economic offensive. For this reason Fabius hopes to be able to increase the number of engineers graduating from engineering colleges and universities in 1985 by 10 to 15 percent. It therefore seems important to increase the number of high school graduates interested in pursuing a degree in engineering. For this reason, the French government has planned broad reforms in this area of lower education: Within the next three years the government hopes to give each high school graduate a comprehensive education in informatics. To accomplish this, the government intends to make available 250 billion francs (around DM 85 million). The schools are to receive 100 to 200 computers alone for student education. [Text] [Duesseldorf VDI NACHRICHTEN in German 12 Oct 84 p 7] 12644

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